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FOR INFORMATION

Question 18/2: Strategy for migration of mobile networks to IMT-2000 and beyond

STUDY GROUP 2

SOURCE: CANTV

TITLE: IMPLEMENTATION OF A 3G PLATFORM ON CDMA20001XTECHNOLOGY IN THE 850 MHZ BAND

Abstract:

This document discusses the various aspects of Movilnet´s (CANTV of Venezuela cellular mobile operator) implementation of its 3G platform based on CDMA2000 1x technology in the 850 Mhz band.

The aspects covered are: the background, study of options, network characteristics and services to be offered, network construction and commissioning, test of operation and conclusions.

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This document discusses the various aspects of Movilnet's (Telecomunicaciones Movilnet de Venezuela) implementation of its 3G platform based on CDMA2000 1X in the 850 MHz cellular band. The following aspects are covered:

I. Background of the situation

II. Study of options: availability of technologies in the 850 MHz band; efficiency of frequency use (traffic handling capacity); compatibility with existing infrastructure; positioning to provide 3G services; international experiences and availability of terminals

III. Network characteristics and services to be offered

IV. Network construction and commissioning

V. Tests of operation

VI. Conclusion

1. BACKGROUND

Movilnet is the cellular mobile operator of CANTV, Venezuela's main telecommunications company, and began operations in May 1992. Since its establishment, Movilnet has experienced sustained growth, its customer base increasing from 8,000 customers in 1992 to 170,000 customers in 1995. Its network was based on an AMPS platform in the 850 MHz B-band (12.5 MHz for uplink and 12.5 MHz for downlink).

During the 1992-1995 period, Movilnet implemented additional services, such as voice mail, digital mobile messaging, call forwarding, and three-way calling. In 1996, Movilnet began to digitize its cellular network, based on TDMA IS-136 technology. This decision enabled Movilnet to become the technological and innovative leader in cellular telephony services. The first services offered were caller ID, SMS, and MWI (Message Waiting Indicator). In late 1996, Movilnet introduced the service that would become the springboard for future growth: Prepaid.

Since that time, its customer base has grown at a tremendous pace, from an average annual rate of 30% during 1994-96 to an average annual rate of over 80% for 1997-99. Services such as international automatic roaming, user authentication (to prevent fraud), CDPD (Cellular Digital Packet Data), SMS-MO (Short Message Service Mobile Originated), M-commerce, and information services were launched on the SMS platform.

This explosive growth began to create pressure on network capacity in densely populated cities, such as Caracas, Valencia, and Maracaibo. The problem in Caracas was aggravated by the fact that the city lies in a very narrow valley of extremely rugged terrain, with widely scattered, densely populated urban settlements among the surrounding mountains with residential buildings averaging 40 meters in height. A major engineering effort was launched to address this situation in order to improve outdoor and indoor coverage and to prevent interference caused by uneven terrain and buildings.

By 1998, with an average annual growth rate of 80%, Movilnet began to anticipate saturation of its capacity that was approximately 50% of total capacity in the main cities. It launched studies of options in the 1900 MHz band with TDMA, GSM, and CDMA technologies.

By 2000, with over 1,500,000 customers and growth of over 90% in 1999, it became imperative to consider the options to deal with potential future congestion. Negotiations were therefore launched to obtain additional spectrum in the 1900 MHz band, while studies of technological options with GSM and CDMA platforms continued.

By 2001, in view of the impossibility of obtaining additional spectrum, feasibility and business case studies were completed for deployment of a new network in the 850 MHz band, with two options, GSM and CDMA, and several requirements: 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 the studies of the two options, six main aspects were taken into account: *availability of technologies in the 850 MHz band; efficiency of frequency use (traffic handling capacity; compatibility with existing infrastructure; positioning to offer 3G services; international experiences and availability of terminals.*

2. STUDY OF OPTIONS

2.1 Availability of technologies in the 850 MHz band

By 2001, only one digital technology could provide solutions that met Movilnet's requirements: CDMA2000 1X. Some manufacturers had announced their intent to provide a GSM solution for the 850 MHz band, but thus far, this had not materialized. Movilnet had to choose either the CDMA2000 1X 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 because manufacturers were not offering GSM terminals in the 850 MHz band.

2.2 Efficiency of frequency use (traffic handling capacity)

To date, CDMA has shown itself to be the technology making the most efficient use of the spectrum and 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 850 MHz band, it was necessary to revise the frequency 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 had the impression there was greater compatibility between these two technologies than between TDMA and CDMA. However, the fact that IS-136 and GSM are two forms of TDMA does not mean they are compatible from either the user (terminal) or the operator (network) standpoint, while TDMA and CDMA networks share the same communications protocol in the core network (ANSI-41).

Such a feature enabled Movilnet to actually share the same TDMA applications and systems on the CDMA2000 1X network. In concrete terms, it meant sharing such important platforms as HLRs (Home Location Register), voice mail, SMS, WIN (Wireless Intelligent Network), prepaid, etc., enabling customers to migrate from the TDMA to the CDMA platform while retaining their telephone numbers and user profiles. This meant considerable savings on systems and duplicate platforms, and facilitated network operation.

2.4 Positioning to provide 3G services

In the year 2000, at the World Radiocommunication Conference in Istanbul, the International Telecommunication Union (ITU) announced the air interfaces approved for the development of 3G services. On that occasion, five radio interfaces were approved: IMT-Direct Spread (WCDMA), IMT-Multi Carrier (CDMA2000), IMT-Time Code (TD-SCDMA), IMT-Single Carrier (UWC-136/EDGE), and IMT-Frequency Time (DECT).

The EDGE (UWC-136) interface had been promoted by the TDMA-136 operators through the Universal Wireless Consortium Committee (UWCC) but for a few reasons including the UWCC's dissolution in December 2000, and AT&T Wireless and Cingular's decisions to implement GSM platforms in their respective 1900 MHz PCS bands in the United States, EDGE was not supported by the operators. Under these circumstances, the most expeditious way to provide 3G services was CDMA2000.

Careful study of a TDMA operator's options in migrating towards 3G shows the GSM path requires additional spectrum (UMTS spectrum), as well as two additional platforms: the GSM and the UMTS network. However, the CDMA2000 path does not require additional spectrum, as it can be implemented directly in the 850 MHz band.

2.5 International experiences

By 2001, European operators had invested heavily to obtain licenses for the use of spectrum required to implement UMTS, and were facing a critical situation. 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 CDMA2000 1X platform could not have been more 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 aspects most studied. Movilnet 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 the latest technological innovations in the terminals. Thus, the decision had to take into account whether a wide range of existing manufacturers were committed to delivering terminals tailored to the applications to be implemented and to market requirements.

Again, the Korean and Japanese experience, with over 40 models at the time, as well as the decision taken by the large US operators (Verizon Wireless, Sprint PCS, Bell Mobility and Leap Wireless), as well the largest Brazilian operator Telesp, to evolve their networks to CDMA2000 1X generated confidence that terminals would be available. Nonetheless, GSM's greater maturity at the time had this point in its favour.

3. NETWORK CHARACTERISTICS AND SERVICES TO BE OFFERED

The CDMA2000 1X network has a unique traffic handling capacity enabling it to provide six times the capacity that the TDMA network would provide, utilizing the same 1.25 MHz bandwidth corresponding to a CDMA2000 1X carrier. Even the Vocoder (voice coder) of CDMA2000 1X is

superior to other technologies in terms of voice quality, immunity to fading (selective fading of frequencies), diaphony, and interference. This is the main network characteristic and the essential reason for its implementation, thereby ensuring Movilnet's solution to capacity problems in the coming years, as capacity may be increased easily by installing one or more CDMA2000 1X or CDMA2000 1xEV-DO carriers (carriers evolved only for data communication at high speeds of up to 2.4 Mbps).

In addition to its huge voice traffic handling capacity, the CDMA2000 1X network makes it possible to provide all digital services that Movilnet provides on the TDMA network (voice mail, SMS, SMS-MO (Short Message Service Mobile Originated), MWI (Message Waiting Indicator), WIN (Wireless Intelligent Network), call forwarding, conferencing, WAP (Wireless Access Protocol), and prepaid) as well as a unique data transmission capacity with speeds of up to 153 Kbps. This capacity is available in every network radio base station and is ideal for the provision of mobile Internet access for PCs, laptops, and PDAs, and of a wide variety of applications and services for cellular terminals equipped to interact with Binary Run Environment Wireless (BREW) or Java to Platform Micro Edition (J2ME) platforms.

Accordingly, along with thousands of applications such as Internet browser, calendar, e-mail, personal organizer, chat, games, location-based applications, medical applications, industrial and entrepreneurial applications to handle sales forces, inventories, etc., which exist on both platforms (BREW and J2ME), local applications are being developed to meet the needs and interests of the local market, as well as applications to enhance communications, sound and image messaging, and terminal equipment facility-related applications, such as ring tones and screen savers.

On the CDMA2000 1X platform, voice and data communications compete for network capacity. However, the design, intended to optimize spectrum use and dormant data channel functions, makes possible efficient coexistence without detriment to the handling of both types of traffic. A noteworthy feature of the CDMA2000 1X network is that user terminal radios transmit with less power than the other technologies' terminals. This means longer battery life and smaller and lighter telephones.

In addition, the new CDMA2000 1X platform is in fact a parallel network to the TDMA network that Movilnet had been installing since 1996, reusing important nodes (Prepaid, SMS, HLR, Voice Mail), due to the previously explained IS-41 compatibility between TDMA and CDMA. Thus, one of this network's main features is national coverage, enabling Movilnet to provide its outstanding services throughout Venezuelan territory.

4. NETWORK CONSTRUCTION AND COMMISSIONING

The project to install and commission the CDMA2000 1X platform consisted, as mentioned above, of building a network parallel to the TDMA network (over 400 cell sites), retuning the entire existing network (AMPS and TDMA) to free the necessary spectrum to deploy a CDMA2000 1X carrier, adaptation of sites for installation of the new radio base stations and the mobile terminals, interconnection, connecting platforms and common nodes to the AMPS, TDMA, and CDMA2000 1X, and adjustment of operating systems, billing, and administrative procedures.

One of the project's main challenges was to integrate the TDMA and CDMA2000 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, voice mail, HLR (Home Location Register), the other voice services, 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.

To enable subscribers wishing to utilize the new network to retain their telephone numbers meant that strategic negotiations had to be conducted with the provider to move forward with tests of a new operating system that would enable subscribers of the two networks to be administered simultaneously, something that had never been done before.

At the time the project began, no platform existed that could enable subscribers' profiles and locations to be stored (HLR) for both networks simultaneously, while handling and administering 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 CDMA2000 1X subscribers by the analogue network had to be evaluated, as several services required fundamental changes. 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 that became an obstacle to integrating CDMA2000 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 communications protocol for prepaid mobile telephony systems. This involved designing new network architecture, in order to meet the objectives by the deadlines without affecting existing systems.

One of the platforms that underwent most change, and which was reutilized optimally, was the text messaging center, which handled SMS traffic sent by subscribers and by different value added services, such as personalized services, SMS, chat, and e-mail notification. To provide these services on both networks, a joint solution had to be designed that would ensure the system's reliability.

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

5. 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 that support commercial operation and customer service. The certification process was conducted on the calls and services as well as the different systems. That is, postpaid and prepaid on-line systems were tested – extranet for agents, voice activation, Movilnet *Online*, operational intranet, SMS. Postpaid and prepaid calls and services were tested in outdoor locations; indoor tests were made in each of the regions' most important structures; handoff tests included maintenance of calls when the receiving radio base station changes, both when going into digital and analogue radio base stations; Interactive Voice Response (IVR) tests included card activation and data transmission.

Tests were divided into postpaid and prepaid categories and the certification team formed was multidisciplinary. The structure of the group was the following: the fault resolution group, who was responsible for monitoring and correcting problems on systems operated in Movilnet; the test execution group, that was formed by the manager in each region and included a body of employees from the regional office, and was in charge for the calls and services 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 that acted as liaison between the regions of each commercial area.

6. CONCLUSION

The implementation of the 3G platform based on CDMA2000 1X technology is an achievement that occurred through the natural evolution of Movilnet's cellular communications platform in its objective of addressing the growing needs of its market, for both voice traffic and for the growing data communication needs, and the objective of providing the best personal communications services.

Since the launch of cellular communications services in Venezuela the country has sustained one of the highest cellular penetration indices in the hemisphere which by December 2001 was over 25%. In the main cities, penetration approaches 40%. The new investments in the CDMA2000 1X network ensure sustained market growth and the satisfaction of users' high service expectations.

The CDMA2000 1X option has extremely important advantages over other platforms for operators needing to expand capacity and provide 3G services in the short term without waiting for other technologies to evolve. It has the lowest investment and maintenance costs and is easily integrated into all existing platforms in the 850 MHz band.

Owing to its low costs it may be used in meeting requirements for rural and outlying areas as well as to provide Internet access facilities, thereby contributing to attaining the universal service objectives of the Americas.

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