TELECOM SECTOR
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1. INTRODUCTION

The objective of this chapter is to present a view of the architectural and technology options that can be developed for the national telecommunication network, for the upcoming 5 years, so that the provision of new services, other than voice services, will satisfy the market demand and offer a major revenue opportunity for the Operator or the telecom provider.

2. METHODOLOGY

The methodology applied for the telecom sector follows the steps as detailed below:

1- The actual network and status is analyzed and assessed
2- Market needs are defined
3- Definition of sector vision and objectives
4- Planned projects are identified

3. CURRENT SITUATION AND NETWORK STATUS

3.1. ACTUAL NETWORK INFRASTRUCTURE AND STATUS

3.1.1. Actual Network Infrastructure and Status for Fixed Network

By the end of 1994, the outside plant network capacity was 420 thousand lines and the connected subscribers were below 200 thousands but their performance wasn't stable or satisfactory. This situation was caused by the direct damages that targeted both the switch exchanges and network during the war in addition to lacking the ability of practicing maintenance or fixing structures or upgrading equipments. Below 8 % of the population used the telephone services (mainly in the big cities).

The local switch lines were specifically harmed and all their network needed to be reestablished again .Next to this, the war conditions and the decrease in the resources of ministry of post and telecommunications declined the quality of the services offered to the customers below the international standards. Also, most of the equipments used were technically obsolete specially that no upgrade was applied.

It became necessary to take the needed steps to enhance the services, so the priority in this field was for the rehabilitation and expansion of the fixed telephone network after considering the new digital systems. During 1995-1997 the rehabilitation of all the telephone exchanges buildings was accomplished and new ones were built in the needy areas , where new equipments were installed in these centers with performing all the necessary connections between these centers and with the customers. The current network can handle 1.8 million customers with the average of one line for each 3 individuals.

At the same time, studies started for reorganizing the ministry for the sake of separation of the operation and maintenance activities from organizing and monitoring. In this regards, the ministry assigned to OGERO the duties of connecting lines to the customers, applying maintenance and issuing bills.

Because of what the government had applied from projects and installations in this sector during this period, Lebanon became the pioneer among his Arab neighbor countries at that time in this field. All this was planned to serve the vision of Lebanon position in his Arabic and international environments and to meet the challenges of the twenty first century, century of advanced communication technology.

Starting 1993, contracts were signed between MoT and each of Alcatel, Ericsson, and Siemens, to supply and install switch where 300 new digital switches and 3 international exchanges have been supplied and installed by these three vendors. The network's transmission system uses a fiber optic backbone SDH (Synchronous Digital Hierarchy) and supports various protocols, with the speed of STM-1 (155 mbps) and STM-4 (622 mbps) transmission backbone. International traffic is carried by satellite, terrestrial microwave, and submarine cable links.

The number of the connected subscribers for voice telephony service does not exceed 600,000 while the copper local loop infrastructure offers 1,700,000 access points to subscribers.

Those 600,000 subscribers, irrespective of the services offered (local, long distance, internet connection) are served through 51 national central switches, 8 transit switches and 3 international switches.

Regarding the high bit rate network offered to the customers, MoT are providing actually only the leased line services, (ISDN) Basic Rate and ISDN Primary rate access with a maximum bandwidth of 2Mbits/s.

Leased Lines: Leased Lines are dedicated circuits that MoT runs directly between two customer sites, providing a permanent connection at a certain speed between the two sites. Two types of Leased Lines are usually offered, Analogue Leased Lines and Digital Leased Lines. Digital Leased Lines offering is more flexible than Analogue Leased Lines in terms of bandwidth, and reaches much higher bandwidth than Analogue Leased Lines. Digital Leased Lines also offer a better quality of service.

With the growth of business communications, Leased Line services have become a Must to be offered by any respectable Telecom operator. This service had been introduced and put in service in 1996 and was subject expansion by end of 2002.

Based on the old circuit switch technology and (TDM) technique, this service presents limitation on the new added services required for new applications and bandwidth

capacity. For a monthly fee of around 2,400,000.00 L.L. for 2Mbits/s link, this high cost of pricing is a major blocking factor behind the mass deployment of the service.

- ISDN service: There are two types of ISDN line access - basic and primary rate access, the primary access not being provided to the public yet although the equipment was technically put in service by end of 2001. Regarding the Basic Access, almost 5,000 lines were put in service in 2000 with only 1,500 lines sold.

Basic Rate Access (BRA) - provides two digital data or voice channels with a maximum bit rate of 128Kbits/s.

Primary Rate Access (PRA) - 30 digital data or voice channels with a maximum bit rate of 2Mbits/s.

Introduced in early 90's for high speed digital connection, this service does not present the same interest to potential customers after the introduction of xDSL technologies. The declining market of ISDN services should be considered by MoT and new tariffing to be applied in order to encourage the rollout of such service.

3.1.2. Actual Network Infrastructure and Status for Mobile Network

The Lebanese government currently owns the two GSM networks in Lebanon. The government had awarded two 4-year management contract agreements in 2004 to MTC and Alfa, after putting an end to the BOT contracts signed with the two GSM operators Cellis and LibanCell in 1993, whereby the two groups receive 209 Million US$ and 201 Million US$ respectively over the 48-month period. These fees cover the operational expenditure (OPEX) Part while MoT covers the capital expenditure (CAPEX) part.

Connected subscribers grew to reach around 800,000 by end of 2002 and were held at this amount until the two new groups took over the management of the network to reach by end of 2004 an estimated amount of 880,000.

However, under Telecom Act no. 431, the government has ambitious plan for Liban Telecom, which is expected to be assumed by OGERO, where a 20-years GSM license deal might be proposed to Liban Telecom as the third GSM Operator in the country. Giving that the number of GSM subscribers is projected to reach 2 million subscribers by 2010, the entry of the third Operator will have a significant and positive effect on the mobile revenues and a decline of ARPU (average revenue per user).

3.2. COMPLETED AND PROPOSED PROJECTS

3.2.1. Completed Projects

3.2.1.1 Switching expansion and software application upgrade project

This project was signed between CDR and the three contractors Alcatel, Ericsson and Siemens on 26/08/2005 for contract period of one year. However, variation orders were added to the scope of works for Alcatel and Ericsson extending the completion of such works till mid of November 2005.

This project would promote the existing switching network to the latest technological platform.

Several conditions have contributed to undertaking this expansion, below are some of the major factors:

- The existing equipment has reached the end of manufacturing line. Any addition or maintenance procedure is being hindered by the non-availability of required equipment.

- The international traffic has significantly augmented in the past years, and that draws the necessity to extend the E1 devices of the international and some of the main switches.

- Upgrade the signaling grid to be compatible with the new V5.2 protocol. This feature enables the interconnection of different kinds of switches from different suppliers.

- The new upgrade engulfs the (ADSL) compatibility, allowing connecting broadband users on the newly upgraded switches through integrated DSLAMs.

- A main feature in this new version is the direct connection of switches over the fiber optic links. The option can be opted where the transmission capacity is being fully saturated, and hence, a direct STM-1, for example, can interconnect two switches over the fiber cable without the necessity of dropping the STM-1 signal to the E1 level (See the attached scheme).

- The new upgrade enhances and augments the memory and speed of the central processor speed. This is achieved by new hardware and software version for all the central processors to cope with the new traffic demands.

3.2.1.2 Leased network

This project signed between MoT and Tetracom/Tellabs in October 2001, provided an extension to the existing leased line network with the following capacity:

627 E1 (2Mbits/s) ports
616 HDSL ports
1518 Baseband ports.

Contract	Contractor	Currency	E1 Ports Installed	HDSL Ports Installed	BaseBand Ports Installed	2/w Ports Installed
Leased Network	Tetracom/ Tellabs	USD	627	616	1518	200
	Ports sold		*130*	*250*	*250*	*0*

3.2.1.3 Internet connectivity

MoT had signed a contract with PCCW in October 2003 for the acquisition of an international capacity and internet connectivity from Jdeideh Central office to USA using the existing cable link between Beirut and Alexandria through the Altar-Berytar Marine cable as MoT does not have any Internet Exchange Center to manage the IP network connectivity over the desired capacity. The 90 E1 (2Mbits/s) provided under this contract were totally purchased by the different ISP.

3.2.1.4 Active cabinet project

This project was signed between MoT and AFC in order to provide an active cabinet network for the provision of telephony and data services for 8000 subscribers in areas, excluded from PSTN and OSP2 projects, which were identified as difficult or expensive to reach by the traditional copper wireline network.

3.2.1.5 Payphone Network

A contract was signed between MoT and Ashada (local Lebanese Contractor) to install 4000 payphones (Marconi) on all the Lebanese territory. The project included fully installed booths and payphones as well as an integrated management system for complete monitoring of all the installed payphones.

3.2.2. Proposed Projects

3.2.2.1 National Public Data Network

During the migration roadmap to full Data/Voice converged network, the basic network infrastructure for broadband data network can start with the implementation of IP-Based PDN (Public Data Network) project whose tender documents had been prepared and submitted to MoT ready for tendering. Under such project (DSL) services will be provided.

DSL achieves broadband speeds over ordinary phone lines. With DSL, home and business users can access high-bandwidth information on demand, with improved opportunities to experience streaming video, online gaming, multimedia applications, and telecommuting. DSL is "always-on". Unlike a dialup connection, there is no logging on and off or waiting for a dial tone. With DSL, the connection is always there - ready to use. In addition, DSL doesn't tie up the user's phone line.

DSL bandwidth is dedicated. Unlike cable Internet access, with DSL there's no danger that a user's connection speed will slow down as more users log on.

DSL is reliable and secure. Because DSL provides a dedicated connection over existing phone lines, it has none of the security risks associated with shared bandwidth solutions like cable.

DSL solves the bottleneck problem associated with delivering network services over phone lines. A DSL transmission is digital. It does not need this conversion. This allows phone lines to carry more bandwidth for transmitting data.

Typically, individual DSL connections provide up to 5-8 Megabits per second (Mb/s) to downstream and about 512 – 2048 Kb/s upstream. A DSL line can carry both data and voice signals and the data signal is continuously connected.

Access is the biggest problem facing Internet users today. The growing demand for access has produced bottlenecks and traffic jams. xDSL high-speed Internet access breaks through the bottlenecks giving users quick, reliable access to high-bandwidth content.

ADSL is the most cost-effective solution for offering new applications to the mass market using the existing copper network infrastructure. Providers can offer ADSL applications as a portfolio of service levels or classes similar to an airline distinguishes classes of seating, such as first class, business, or economy. There is hundreds of educational, residential, business, and government applications served effectively by ADSL technology.

Here are a few examples of applications:

- **Voice over DSL**

Voice over digital subscriber line (VoDSL) is a DSL technology that delivers voice services over DSL using Asymmetric DSL (ADSL) or SHDSL (Symmetric High Bit Rate DSL) to integrate voice with data services. VoDSL gives service providers the ability to offer residential and small- and medium-sized business users, high speed data and multiple voice channels over a single telephone line. By offering voice on the same DSL technology as data services, VoDSL offers providers new revenue opportunities they can easily and cost effectively deploy using their existing DSL infrastructure.

- **Video on Demand**

Video on Demand allows you to access any video program that you are interested in watching, whenever you want to watch it. Watch a new first run movie or view your favorite movie classic. You could take a video tour of your dream home, go online and play the latest video game, or take a virtual visit to a vacation spot and see if it is the right one for you. With Video on Demand, you can do all this and more over your existing phone line and still place and receive telephone calls at the same time.

- **Video Conferencing**

Video conferencing provides a tool to improve meetings, telecommuting, training, or services for businesses with multiple sites or between businesses, through offering face-to-face communications. Businesses that operate multinationally can benefit from video conferencing wherever the physical location.

- **Telecommuting**

With telecommuting, employees can work at home and have all the access capabilities that are available when they work in the office. As a telecommuter, an employee can access a virtual local area network (LAN) with other telecommuters, access application servers, share files with co-workers, and browse and retrieve faxes that arrive at the central corporate fax server. Telecommuters can receive e-mail and have the bandwidth available to retrieve messages from a voice mail server.

- **Tele Medicine**

Tele Medicine is an Internet-based application that enables users to access information stored on a server database via a Web browser. This service, which simulates a medical record database, allows users to retrieve and view patient information, diagnostics, prescription, and graphical data such as x-rays. With Tele Medicine, doctors can provide better care for their patients. A doctor could get a patient's most recent records, quickly, from a hospital or other health care facilities; the system could transmit a patient's medical images to a specialist for consultation while the patient's doctor is consulting the specialist; or, a hospital could retrieve a patient's medical history in an emergency.

- **Telelearning**

Telelearning, or interactive education, promises to revolutionize educational opportunities for children and adults. High speed Internet technology offers schools fast and cost-effective access to the Information Superhighway. Schools can connect to and from the Internet, other schools, community colleges, and universities, local and national

libraries, teachers and students' homes, and district offices. Telelearning services can include in-school interactive learning programs, in-home supplemental educational materials for students, "Edutainment" programs geared to pre-school age children that incorporate interactive learning elements or simple learning games, adult training and education courses on demand, and virtual classrooms.

- **Interactive Network Games**

Interactive Network Game applications support interactive and multi-player computer games across an IP-based network. After subscribing to this service, users can select a game from a menu. The service then launches the selected game from a remote drive. Interactive Network Games cover the spectrum of computer games from multi-player car racing to Java-based action games. The games range in size from under 2 MB to over 2 GB for animation and video intensive games.

- **Broadcast Audio & TV**

Broadcast Audio & TV captures and distributes "live" TV or audio streams across an IP-based network, demonstrating the "live" broadcasting capabilities of ADSL high speed Internet. With ADSL technology, an audio or video stream captures only a part of the available bandwidth so users can continue to "surf" the Internet while listening to CD-quality music or watching a "live" TV broadcast.

DSL Demand Modeling in Lebanon

The approach taken compared the Internet access profiles of various European countries, which had a longer history of providing Internet services than Lebanon. European countries were selected because they had more reliable data. Also they are deemed to be closer to the culture of Lebanon than countries of North America. The best estimate and optimistic scenarios shows that the penetration of DSL connections per 100 phone lines can easily reach 20% by 2015, totaling 130,000 DSL connections providing most efficient means of broadband benefits to homes and small or medium sized businesses.

3.2.2.2 Extension of Internet Connectivity

As previously mentioned, all the internet links provided under the Internet connectivity project were totally consumed and MoT are preparing a new tender for the expansion of the connectivity with additional E1 connections.

3.2.2.3 Extension of the Transmission Network

The transmission network started in 1994 and the design was built based on the penetration factors and 10 years demand forecast. Today, with the new demand forecast for voice and data services, the re-evaluation of the transmission network based on the new convergence for the multi-media transport network must be defined for the future strategies of the Operator.

3.2.2.4Additional Value Added Services to the IN platform

MoT is preparing to add a new prepaid telephony service on the fixed network: PPT. This service will associate a prepaid account to a PSTN/ISDN line. The subscriber can phone at any time until the limit of the prepaid credit is reached.

3.3. VALUE ADDED SERVICES OFFERED

A series of value added services was introduced at the end of 2004 on the fixed network, offering services such as prepaid cards, televoting, toll-free calls, Premium Rate service… and many others that could be a major source of revenues to MOT. With the exception of PrePaid Card services (Kalam through Intelligent Network platform and Telecarte for public payphones), the following special services, purchased and implemented in the Intelligent Network platform, still await a new billing platform capable of handling such services and to adapt them to the fixed network:

- CMM(corporate mobility manager): It is the generic product emphasizing on three main drivers for business environment to implement an advanced voice-VPN (virtual private Network) solution

- FRC(flexible routing and charging service: It enables the set-up and adaptable call handling depending on the location of the caller and the called numbers, on the time of call, and to charge the caller based on pre-specified tariffs. It is also characterized in allowing for the receiver to accept the call expenses.

- TVS(televoting Service): This service allows for carrying out polls and statistical inquiries: It allows for television gaming to be carried out on the wireline fixed network.

Contract	Services Offered	In service	capacity	active users (average)	Comments
Intelligent Network	PPC: prepaid card service	Yes	200 k accounts	120 k accounts	an average of 5000 accounts are daily activated
	CMM:(corporate mobility manager):	No			Putting in service requires the upgrade of the billing system
	FRC(flexible routing and charging service	No			Putting in service requires the upgrade of the billing system
	TVS(televoting Service):	No			Putting in service requires the upgrade of the billing system
	Hardware/Software				

4. SECTOR OBJECTIVES

4.1. TELECOM SECTOR VISION

The future vision of telecommunication should begin with a full scale program from the Ministry of Telecommunication to reforming their network and service infrastructures. Prerequisite for realization of such a vision is the convergence of the current multiple networks - each employing different transport and control technologies - into a unified, multi-service, data-centric network offering services for different demands and at a reduced costs on open service platforms. The necessary technological and environmental underpinnings exist today for next-generation service providers to begin the process of transforming their infrastructures to enable the provision of new services promptly and with value added services to the fixed network. This will open a path for introducing a state-of-the-art network based on a network convergence within what is called the “next-generation networks (NGN).”

4.2. MIGRATION FROM PSTN TO CONVERGED NETWORK

The Ministry of Telecommunication should be driven by liberalization, competition, technological advances and evolving market demand by implementing and upgrading the existing telecommunication transport layer for voice and data. Next Generation Network (NGN) holds the promise of offering data and multimedia services, giving access to new revenues. It must be understood that there is no “one size fits all” approach, and that the

content of the proposed evolutionary steps may vary. Traditional switching systems will coexist alongside new technology elements for a number of years.

With the growing number of internet users (250,000 users by end of 2004), MoT are providing connectivity to Internet Service Providers (ISP) through narrowband (PSTN or ISDN) dialup services, or through leased lines for a small number of business customers. The actual switches are highly reliable within PSTN infrastructure but never optimized for data or multimedia. Consequently, as more and more data traffic flows onto the public network via Internet, it has become apparent that a new and more data centric approach will be needed for the common transport of voice and data.

With the completion of software and hardware upgrading process of the terminal switches (Switching Contracts Addenda –Alcatel, Ericsson, Siemens- 2004) after which the switching system of the Lebanese network is actually running on the latest software platform, a platform that is ready for the packet converged network, the following steps should follow:

- the provision of an evolving and a multi-service billing platform,
- Implementation of a packet broadband data network, whose tender documents are already submitted to MoT,
- deployment of xDSL services through a converged network, and
- implementation of the softswitches which allows for:

    1. reduction in Opex and Capex
    2. Delivery of incremental services to users with a reach, cost and capability set superior to those of any competitor
    3. A telecommunication platform that provides rapid and cost-effective innovation
    4. Rapid integration of new services
    5. Economies of scale from the deployed broadband infrastructure

5. NEW TECHNICAL APPROACH

5.1. MULTIMEDIA CONVERGED NETWORK

"Most of the infrastructure of the Lebanese network, be it switching or transmission, is more than 10 years old and is based on technologies developed more than 15 years ago. Some of these technologies have reached their end of life cycle and it is becoming more and more costly to maintain them or to update them." In fact, since the installation and the putting into service of the telecommunication switches, the Ministry of Telecommunication (the sole Operator however qualified as the "Incumbent Operator" as per the last definitions and classifications of the current competitive context) has implemented a first software upgrade for its Alcatel and Siemens switches for a total value of USD 5.5 millions followed by a second upgrade on its three switch types

(Alcatel, Ericsson and Siemens) for a value of USD 7 million. This does not include the price of the hardware that has become obsolete and under dimensioned, and which was supposed to provide additional services and new applications to the Operator while only the voice services are currently being offered.

Going towards a new *Next Generation Network* (NGN) implies an infrastructure oriented towards IP technology that integrates a multitude of telecommunication services: voices, data, video, etc. from fixed access points (xDSL, fiber optic network) or mobile access points (GSM-GPRS…). For an NGN multiservice network, a radical change in equipment and system architecture is mandatory. In an NGN infrastructure, the voice calls are controlled by a digital server, called a "softswitch". This processor controls all command functions. A new NGN would allow to change the network hierarchy and the overall design philosophy of the Lebanese network, which is currently made up of 51 main switches connecting 263 remote switches so that:

- The 51 local switches would not be main switches anymore but will be remote switches to the transit level switches.

- The 8 transit switches would be replaced by softswitches thereby having the double function of transit and local switches.

- The other innovation brought up by NGN is related to the service access network. The choice of the access technology to be used will now only depend on cost and on bandwidth requirements: Ethernet and fiber optic for high bandwidth, xDSL with copper connection, or radio network 802.11 for medium size bandwidth. The possibilities to have multiple services through NGN would result into considerable savings to the incumbent operator (MOT) since the outside plant network is already available and would be used by the NGN network at no additional investment cost.

The following maps illustrate the evolution from the actual network to the migrated switching network.

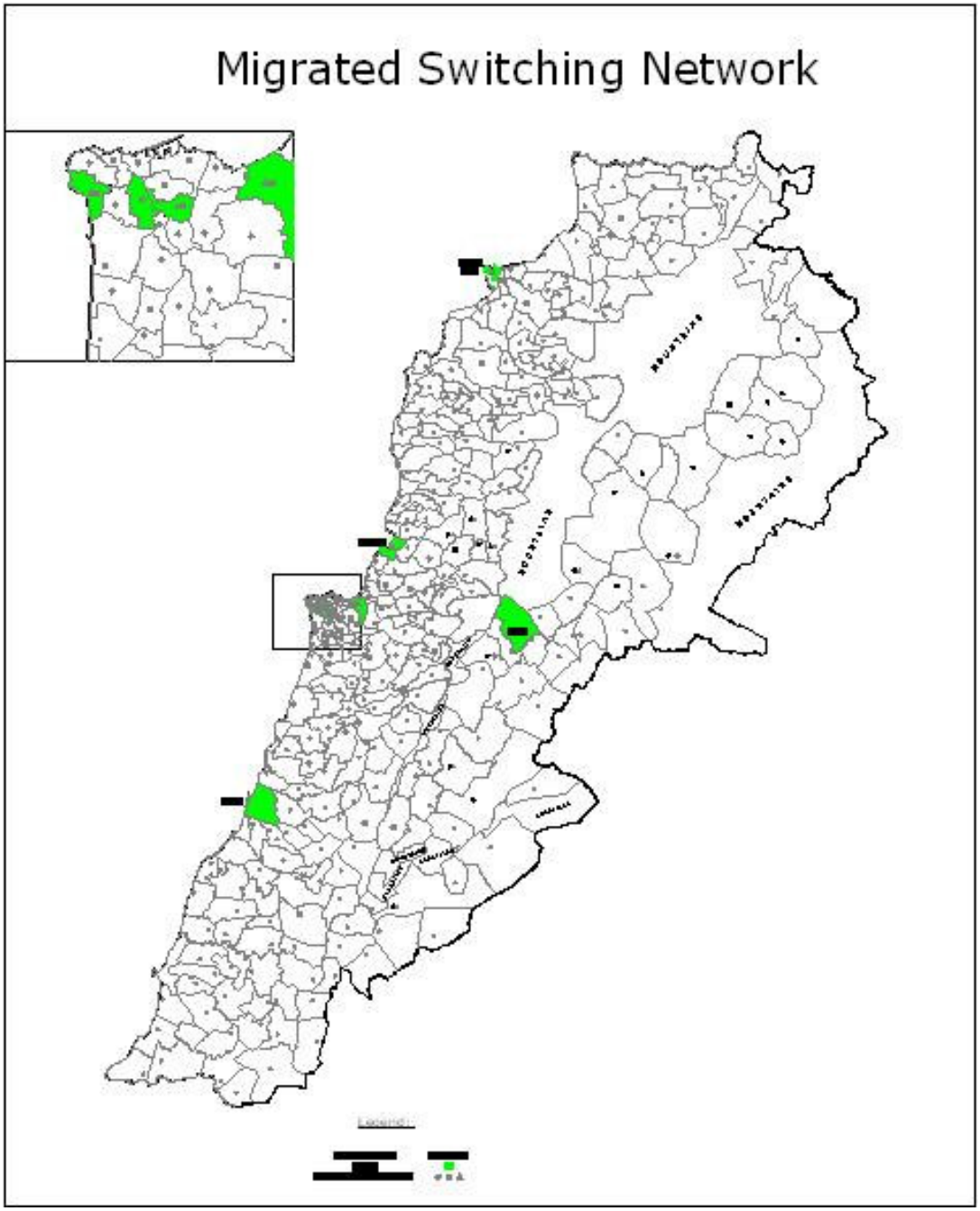


Figure 1: Migrated Switching Network

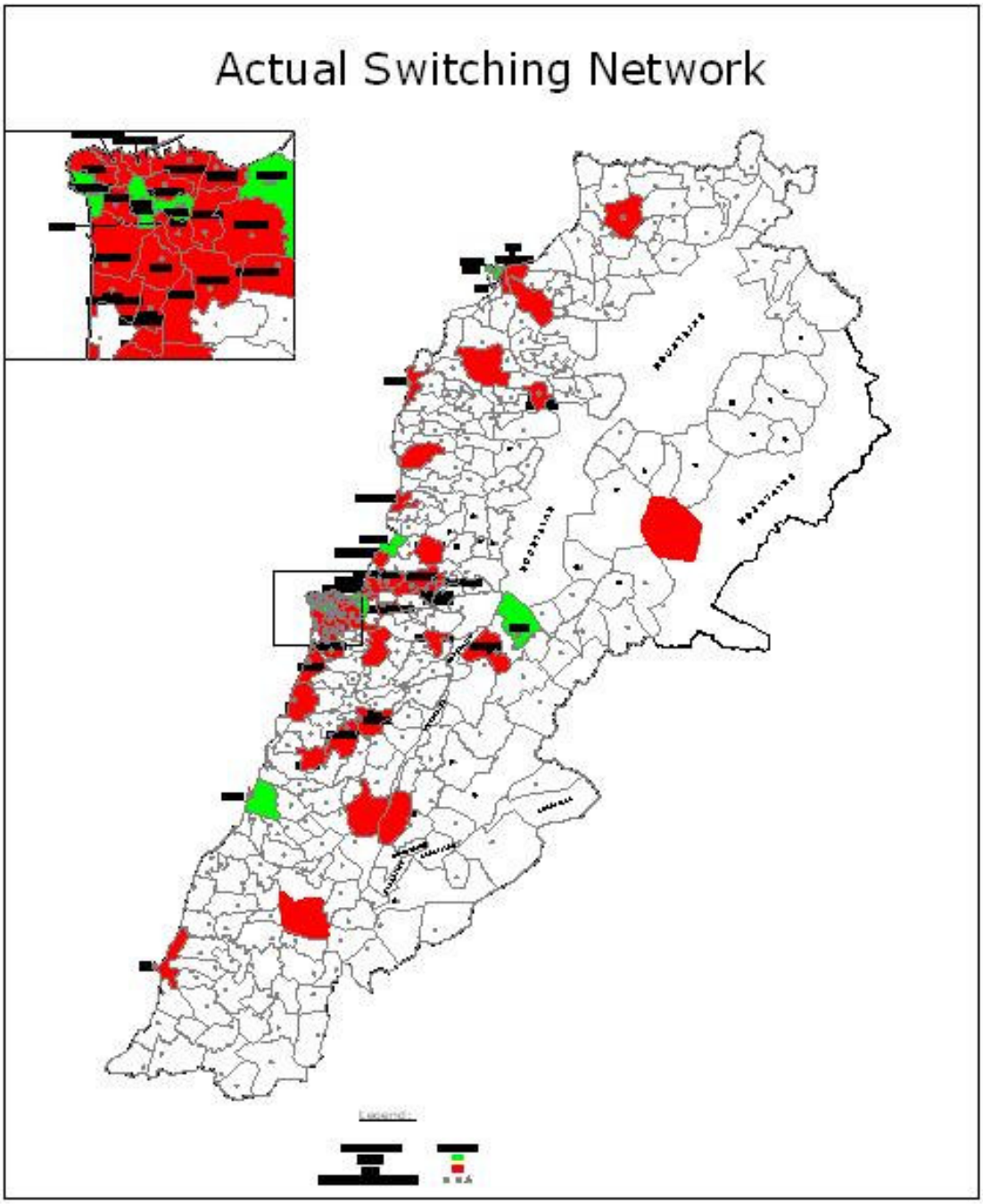


Figure 2: Actual Switching Network

Today, market demands for improved and new services put pressure on operators for a migration to new technologies that can no more be ignored. The dynamics of competition is a trigger to mutation and changes. In order to be competitive, the incumbent operator MOT must provide a range of new and innovative services that the subscribers are demanding. At stakes is the provision of new revenue generating services that would overtake the existing declining ones, mainly by betting on

increasing the conversation of voice – data and / or fixed – mobile services. An NGN network would allow for such convergence by providing the technical means to do it and at the same time by allowing fast commercialization of such converged services that in turns would minimize cost and increase revenues, factors of primary importance in a competitive environment. Furthermore, the possibility to add services independently of the infrastructure network and access points connecting the subscribers to the NGN network is a major source of potential revenues.

Depending on the market situation that varies between different countries, the first phase move (implementation time frame of 4-5 years) to NGN scenario for the Lebanese telecom network would consider the following sequence of evolutionary steps:

1. Step 1: PSTN Consolidation

Network infrastructure optimization will reduce operational expanses and generate additional revenues:

a. Switch consolidation
   Selected small and redundant main switches will be converted to local remote access terminals

b. Access consolidation and voice over DSL
   Deployment of the new access technology, through actual switching network elements, that enables seamless multi-service access to voice (POTS, ISDN) and data (xDSL, IP, etc.) services and which paves the way to NGN's.

c. Intelligent Network - Internet (or any value added services to the fixed network) convergence

The offered Intelligent Network service may be upgraded to integrate voice and data into common applications. Example: click-to-dial, internet call waiting, unified messaging…

2. Step 2: Voice-Over-Packet Trunking

As one of the main goals of NGN introduction is to move to a unique, packet-based infrastructure, voice transport will have to smoothly migrate to packet (mainly IP) network to offload the voice from their TDM Network. This step toward packet trunking network migration will guarantee and protect the TDM investments as it will provide the Operator a full continued access to the existing TDM network elements, while providing the Operator a full trunking-over-packet solution. This requires a complete upgrading of the transmission SDH network that enables the expansion of the transmission bandwidth as well as the required evolution to the NG-SDH (New Generation SDH).

3. Introduction of Softswitches

The 8 transit switches would be replaced by softswitches thereby having the double function of transit and main local switches hosting all the remaining exchanges that would have only remote terminal functions.

5.2. MULTIPLICATION OF PRODUCTS

The actual Lebanese telecommunication sector, marked by a very strong implication of the Government strategy and political consideration or even obligation, must follow its course of dislocation. Initially, the monopoly is reached. International then national competition breaks the tariffing balance. With the necessity of introduction of the "Networks and Value Added Services", the actual monopoly is to move towards "public network opened for third parties", and the opening to the competition of all the segments of the market, implying the end of the monopoly, is planned for 2006-2007.

Gradually, market and user specific demands act like a structuring engine, whereas the telephone network had primarily developed in logic of undifferentiated offer. The transformations are directly related to the evolution of the developed products. Of a universal and generic product, we move towards new classes of services of which some preserve the standard characteristic (the voice telephony is coupled with new offered services) and others tend towards a specialize-dedicated characteristic (dedicated and specific oriented services), which explains the need for the diversification of the structures of offer and the adaptation of the sectoral institutions. The offer tends to be specialized to dedicate specific services, i.e. to provide a service to a specific group or class of users or a particular user.

5.3. THE EXTERNALITIES OF NETWORKS

The externalities of network result from non-commercial interactions. They are not inevitably related to requests from the consumers, but directly depend on the use of the production elements of other companies. Nevertheless, the externalities of network include the pecuniary externalities, because the externalities of network would allow the reduction of the production costs and thus decrease the selling prices.

The general definition of the network externalities resulting from the use of a technology is as follows: "the externalities of a network are presented in the form of individual satisfaction or benefit that the firms can get from the applied technology and that these individual satisfaction or benefit increase with the effective or potential number of the subscribed customers."

Consequently, satisfaction and benefit from the offered service depend on the total of number of the subscribed users.

Problems of the externalities of network can be viewed to explain what could seem a paradox: whereas we could believe that the use of digital infrastructures would make it.

In fact it is not a paradox if we further study the process of the implementation of the companies, first around the search for the externalities of the network and second around the strategies of the local network infrastructure provider, who saw, following the laws of decentralization, their capacities increased in terms of offer of infrastructures, and of the strategies of the telecom operators, who, following the deregulation of the sector, are concerned with the profitability of their infrastructures.

The performance and the production of the firms within a community are positively correlated with the degree of connectivity of these firms, i.e. with the number of firms connected to the shared network. From the infrastructures provider side, the externalities of the network will be considered. Indeed, deployment and expansion of the broadband network infrastructures, is characterized by high fixed costs which limit the possibilities of installation of parallel networks by other competitors and allows the company, which installs or the community which finances the network, to apply tariffings that enable him to generate revenues. The operator or the community will thus may find it beneficial to install a network netting the dense zones in agglomerated companies.

See Solidere infrastructure

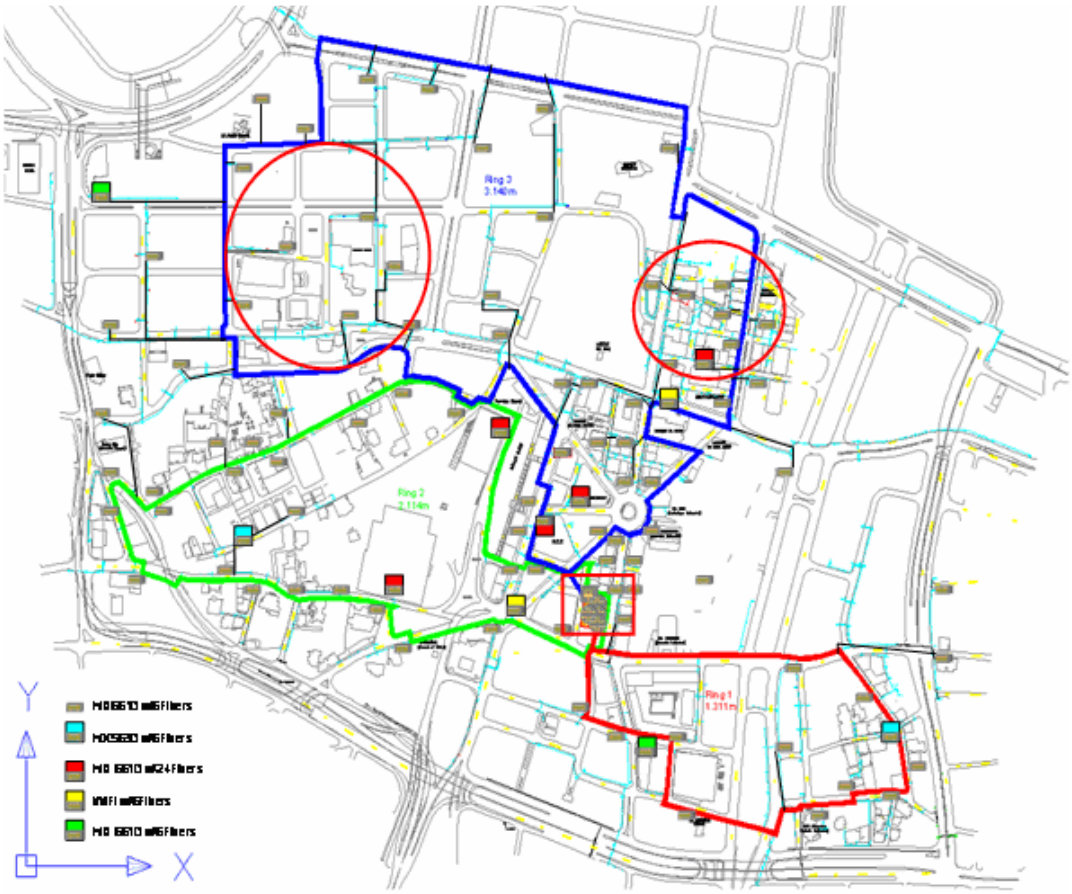


Figure 3: Solidere Infrastructure

One can conclude/understand then how the strategies of the private operators and the local communities reinforce the effects of agglomeration. Indeed, by a qualified effect of positive feedback, one will attend a snowball effect which will accentuate the effects of agglomeration whereas the intrinsic characteristic of digital technologies was to decentralize a number of activities. This mechanism of positive feedback can be summarized as follows: If an infrastructure starts to be adopted by several companies, it makes it possible to its supplier to carry out large scale economies and thus to lower the selling price. This fall of price will involve a rise of the demand which will cause externalities of networks and will stimulate the demand. This flow of demand will again retroact on, by the means of the mass deployment economies, and facilitate the fall of the prices, and again allowing the increase of demand until saturation of the network.

But this snowball effect cannot start unless there is a potential number of users sufficient beyond which the externalities of networks would appear.

This is why the telecom operators install their networks of high bandwidth in the existing agglomerations, thus networks of low size but strongly meshed, rather than of the wide area networks with low and poor transactions or business activity.
The same logic of agglomeration can be also the result of public policies. Indeed, in the case of France, like countries of Europe number, national competitiveness lies within the scope of a territorial competition, i.e. of a competition between regions/areas.

The decentralization regulations should gradually conferred on local authorities the authorizations to attract the productive investments. Whereas the government, during the last glorious years had strong prerogatives on the localization of the productive investments keeping the objective of balanced planning and development between different regions, today the national wide organization is the consequence and the result of the strategies of the local communities.

In such a context, to attract productive investments, the areas may find it beneficial to be more competitive in the infrastructure telecom sector than their closer neighbors.

Thus, to be more service attractive sector, an area has more interest to play and manage with the externalities of network in order to propose services at the best price to companies and firms who are seeking a site of location.

Local communities being able to finance the deployment of broadband network infrastructures and to propose the use of these infrastructures to the business sector and activities, based on new communication deregulations, they will seek to profit from the large scale economies by superimposing the network with the current activity in order to reach the critical mass deployment level beyond which positive economical and social feedbacks appear within the local community.

6. INSTITUTIONAL APPROACH

6.1. DEFINITION OF ACTUAL RESPONSIBILITIES OF THE GOVERNMENT AND SECTOR ORGANIZATION

The Lebanese Ministry of Telecommunications is the monopoly provider of fixed telecommunications services. The services are provided through OGERO (Organisme de Gestion et d'Exploitation de l'ex Radio Orient) whose role today includes the operations, maintenance, sales, marketing, billing and management of the Ministry of Telecommunications fixed network in Lebanon.

OGERO was conceived in 1972 to manage and operate the telegraph and submarine telecommunication of Radio Orient (the early 1900's company). It is 100% owned by the government and acts under supervision of the Minister of Telecommunications. OGERO is currently operating as a Public Utility financed by the State Budget.

The role of OGERO is expected to grow, especially when the planned liberalization of the Lebanese telecommunications sector occurs. OGERO would then gradually undertake the provisioning of all telecommunications services and products in the whole of Lebanon. OGERO will develop into becoming the new Telecom incumbent operator in Lebanon: "Liban Telecom". OGERO's services roadmap include:

- Fixed, National and International Telephone services, with a WLL (Wireless Local Loop) access in many rural areas.
- Star services (Call Forwarding, Call Waiting, CLIP, etc)
- Leased Lines
- ISDN BRI
- Telex
- Public Payphone network
- IN (Intelligent Network) services.

Operations activities – Fixed network

First let's identify the main activity areas within the organization of OGERO (Fig. 1). Network operations cover functionalities such as network operation, procurement, deployment, and maintenance. The first three factors have direct effects on capital costs, while network maintenance connects with operating costs. The main maintenance functions are fault and alarm management (supervision, site or remote intervention and repair), and configuration of the network and network elements (switching, transmission, power plant, cabinets…). Additional to maintenance are provisioning and activation/deactivation of services, subscribers, and network elements, and so on. It is a classical category of network management tasks that OGERO and MoT belong to. For the most of the network management tasks, activities are centralized in the separate organizational unit or network operating center (NOC)/Operation and Maintenance Center (MOC) located in Ras El Nabeh.

The maintenance issues are especially important for a good performance and functioning of all the network elements for access and transport networks. This includes:

- preventive routine tasks
- different level of intervention on sites for urgent, immediate or differed actions
- data collection related to failures and performance for processing and statistical reporting
- Stock management
- Training programs
- …

Under the term "customer operations" are summarized all activities dealing directly or indirectly with the customers or subscribers:

- customer care
- Subscriber connection to access network
- billing
- subscriber administration; activation, de-activation, creation, subscription for additional services (known as Star Services)

- marketing
- sales
- Help desk for the Value Added Services (Kalam, Telecarte)
- Leased lines services (Broadband connections for business customers)

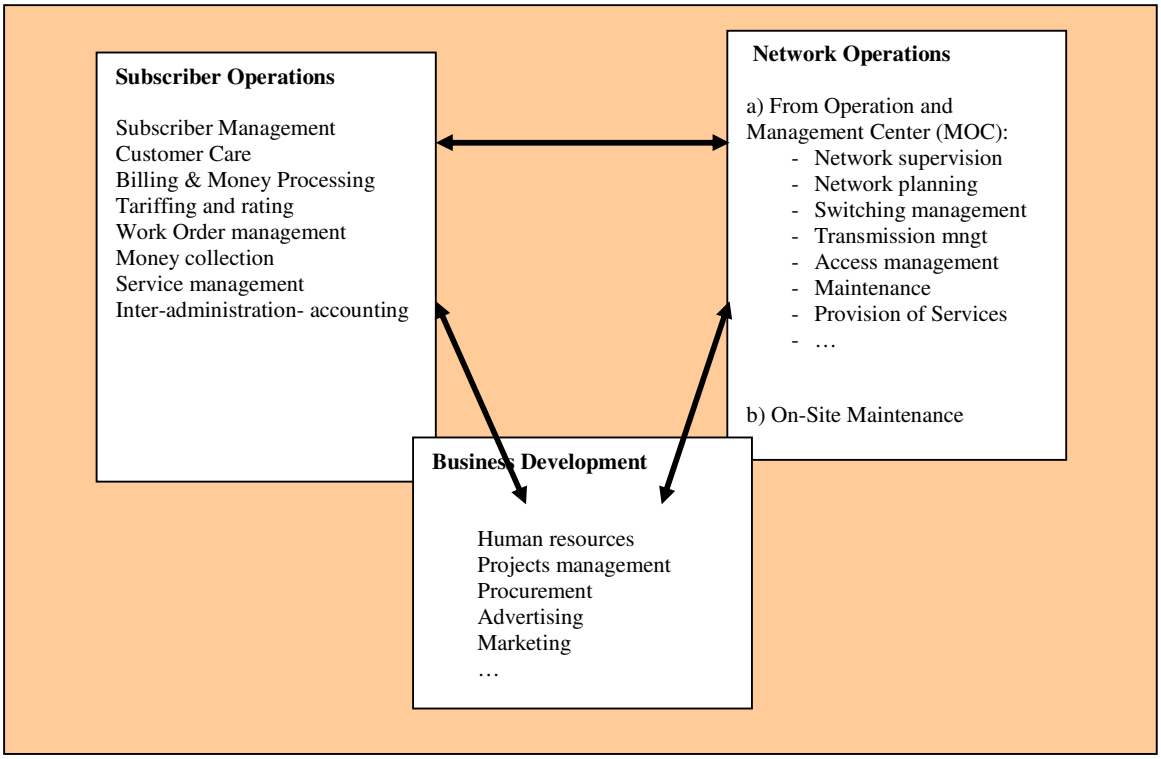


Figure 4: The Main Areas within the Maintenance and Operation Activities

From the figures collected from MoT, as the financing agency of OGERO, the yearly running cost of the operation and the maintenance of the entire telecommunication network are summarized as follows:

- Provision of services (connection, activation): 3,000,000,000.00 L.L
- Maintenance: 28,000,000,000.00 L.L
- Human Resources charges: 100,000,000,000.00 L.L
- IT/Billing: 500,000,000.00 L.L

For a total of budgetary cost of 131 billions of L.L. per year, the average cost of 145 US$/year (based on the actual active 600,000 connections) for the maintenance and operation per wire line is far beyond the average of 70-90 US$ spent by an operating company in an competitive environment during a comparable 10-year period after the initial investment period (the rehabilitation of the Lebanese network started through PSTN project in 1993) especially when 75% of the total cost is spent on the personnel division to cover salaries and all related items for a total number of 1700 employees.

It should be noted that revenues from the fixed network is still declining since year 2000 (a decrease of 6% of revenues expected by end of 2005 compared to 2004).

6.2. FRAMEWORK FOR PRIVATIZATIOON REGULATIONS

In May 2000, the Lebanese Parliament enacted a privatization law, which sets the framework for the privatization of state owned enterprises. The Government established the **Higher Privatization Council (HCP)** to oversee the privatization process of several state owned organizations in vital economic sectors such as telecommunications. The TRA's main mission and responsibilities would essentially be to regulate the telecommunication sector in Lebanon to achieve a competitive environment and to enhance the offered services in order to develop the sector and benefit the economy:

- Sector's policies of all responsibilities below
- Establish regulations and procedures and take decisions
- Technical and economical supervision in general
- Competition supervision
- Interconnection supervision
- Scarce resources supervision
- Frequencies supervision plan
- Licenses (Issuing, monitoring & controlling)
- Conflict resolution
- Total service
- Tariff supervision
- Inspection and Investigation
- Impose Penalties and fines and estimate damages
- Cooperation with other operators
- Relations with International organizations (UPU, ITU…)

7. ECONOMIC APPROACH TOWARD NETWORK INFRASTRUCTURE

7.1. OPTIMIZATION OF NETWORK BANDWIDTH

The Operator MOT would be confronted to the technological dynamics as far as transport infrastructure and transmission equipment is concerned. To study infrastructure economics requires a good understanding of the means to optimize the use of the pipes through which the voice-data information shall pass. It requires the appraisal of the necessary investment, the required capacity, the prevention of backlog, the definition of the tariff structure for each and every service and further to know how the packet data transmission would be handled by a cooperative network and how to interconnect it to other networks.

As a first example, multimedia applications require an ever increasing bandwidth, this being paid on the basis of real usage of multimedia and this for several reasons:

- the difficulty to identify all the operational cost of the network
- the volatility of resources

The complexity level reached by the traffic flow is such that it is impossible to be able to distinguish all individual usages and to have a precise measure of the amount of information exchanged between the entire subscribers. The re-dimensioning as well as the expansion of the transmission network towards the new adequate technology at the national level shall depend on the cost of transmission of information supplied, which shall be adjusted to its actual physical size.

Whatever the technical solutions selected, transmission of multimedia must be as fluid as possible. Indeed, if the network has the positive benefits of allowing all subscribers to exchange information at low cost, the congestion of the network would offset these positive benefits which would result into a high social and financial cost to the subscribers.

The congestion problem, already found on the network of the big cities and namely of the city of Beirut even before the introduction and commercialization of the high bandwidth network is a transmission problem, however purchasing additional equipment will never be the optimal solution to the congestion problem. Indeed, investing in the existing voice oriented technology rather than in the new NGN technology (New Generation SDH, Softswitch servers…) is not an efficient solution.
As long as the network offers one service, which is the voice telephony, the offer (service) merges with the activity of design-construction-management of the technical network. There is lack of differentiation of the network and the service in a situation of single product. In such case we usually consider (until recent qualitative differentiation) the telephone as being the single service offered, even if various uses and various connections coexist.

7.2. DIFFERENTIATION OF SERVICES AND INFRASTRUCTURE

The phase which follows the delivery of the universal service is marked by the qualitative differentiation of the services, itself permitted by a major technical change for telecommunications: the digitalization of the signal. This technical evolution, which makes possible differentiation, is supported by the market trend towards the universal service: the passage from the single product to the multi-production services is the base element of the service offering model. In a single product situation, the large scale economy is a sufficient condition of the natural monopoly. In multi-product situation, on the other hand, this proof of the natural monopoly is insufficient because it is necessary to consider not only the large scale economy but also the product based business.

Network industries show quite particular characteristics. They can be analyzed like a superposition of two complementary items or entities: an infrastructure and services. Usually, the physical infrastructure of the network remains in a situation of natural

monopoly whereas the sector of the services is a potentially competing area. In such case, the end user service provider (Operator) use the infrastructure, qualified then as Basic Infrastructure, as an input to which they are inter-connected and discharge on the other hand the access to that physical network. The manager of the Basic Infrastructure then holds a dominant position on the market. The conditions of access to its infrastructure represent the key parameters of the opening to competition. In order to avoid any possible dominant and abused position, the old monopoly had been in certain case dismantled. The local loop remains for the moment in situation of natural monopoly. On the other hand, long distance communications, mobile telephony or added value services will be regarded as potentially competing services. An operator offering such services must then be inter-connected with the local area network to reach to the end user.

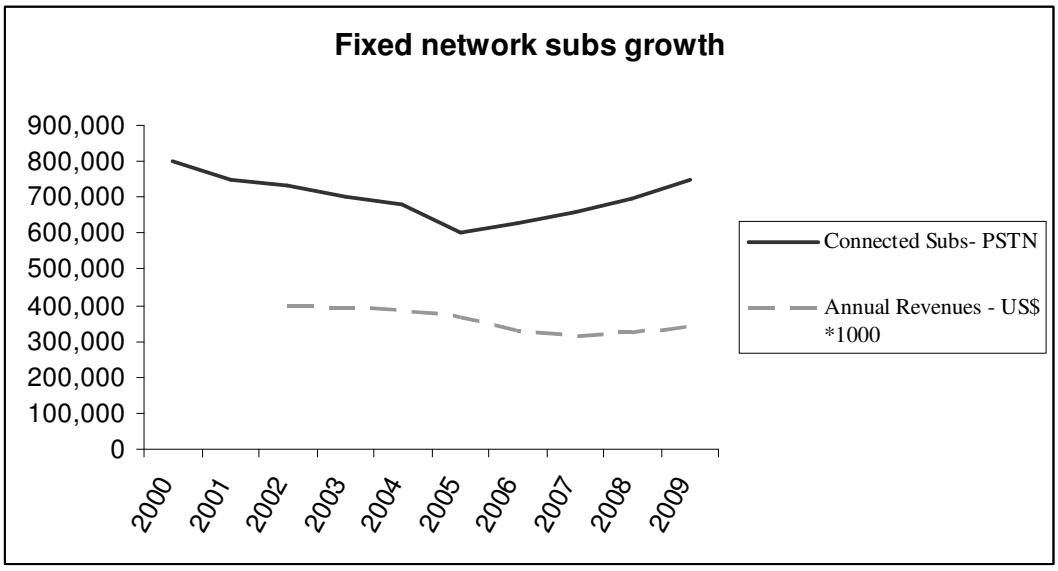
The coexistence of differentiated services reveals a clear distinction between the network and the services. The evaluation of the technical network encounters fixed costs, input constraints (financial thresholds, technical skills...) during the creation or the implementation of the network, and finally of the externalities which limit the possibility and the effectiveness of the concurrent offers. These elements necessarily do not lead to the monopoly; they induce certainly an oligopolistic situation. The networks remain marked by the characteristic of the fixed costs and the increasing outputs. To decide if differentiation is more effective by multiplication of the services or multiplication of the networks is consequently one of the major questions to the organizations of regulation. To support the offer of services of telecommunications without running up against the technico-economic limits of the multiplication of the networks, it is then imperative to adopt a regulation known as of Open Architecture. It is then for the network operators to deliver to the service provider the same services that they use for their own services, in order to develop competition. However this attempt of regulation of the market encounters great technical and political difficulties. It is in particular a question of opening the infrastructures without blocking their rate of diffusion and innovation. Consequently control and tariffing (highest in the area for all services - mobiles, fix, narrowband, broadband and even long distance) are the major and frightening problems, who delayed the strategy achievement of open infrastructure.

7.3. TELECOMMUNICATION MARKET GROWTH

7.3.1. FIXED NETWORK AND REVENUES GROWTH

With the planned privatization of Lebanon's fixed line operator and market liberalization, the decline in PSTN network revenues and penetration will be replaced with a modest increase in the number of fixed lines in the coming five years where the number of fixed lines is expected to reach 750,000 by 2009 growing by a CAGR of 3.6% between the years 2005-2009. Wireline penetration is not expected to exceed the 18% mark by 2009, moving up by 1% from 18% by end of 2004.

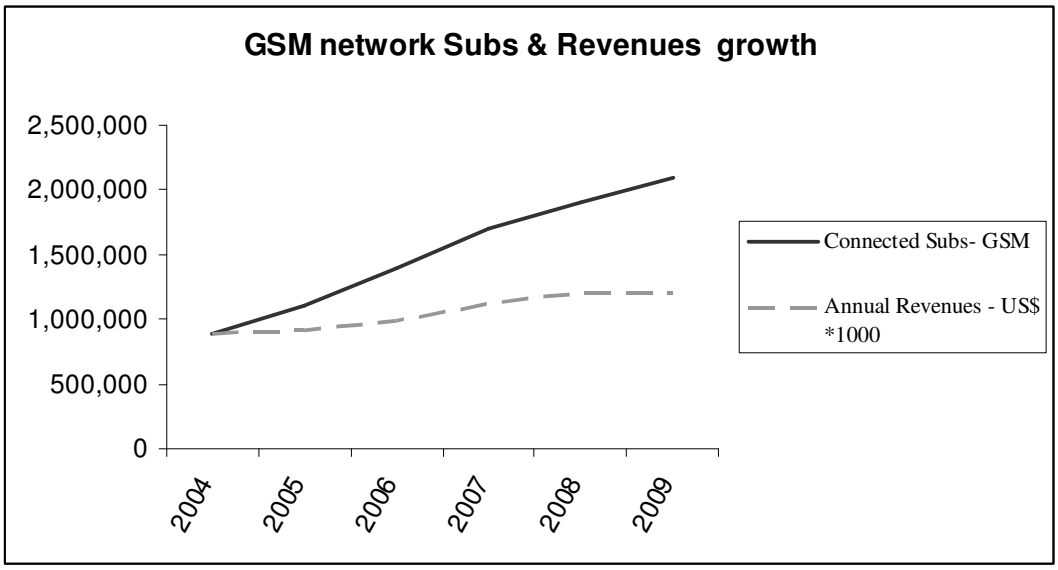
The expected growth in the number of connected fixed lines will be mainly spurred by the growth of the business sector, population growth, acquiring of second fixed lines for Internet Dial-Up connections and xDSL subscribers when such service is offered.



7.3.2. MOBILE NETWORK AND REVENUES GROWTH

Under the same privatization and market liberalization strategy, the number of GSM subscribers, which stood at a mere 880,000 by end of 2004 is expected to reach 2.19 million subscribers by end of 2009, growing annually by a CAGR of 18% from 2005 to 2009. Cellular penetration, 22% by end of 2004 ranked as the lowest between the neighbor countries, is therefore projected to reach 55%. The expected entry of the third GSM operator in or after 2006 will have a significant effect on the possible application of these optimistic expectations as well as a positive effect on:

- ARPU (Annual Revenue Per User) which is should reach US$ 45 by end 2009 compared to US$ 80 by end 2004
- GSM annual revenues to reach 1.2 billion $US in 2009.



7.4. CONCLUSION

Rapid request growth of the data network, particularly the internet, to meet the needs of different customers, residential and business, and the different national market sectors is actually leading to inefficiencies and even deficiencies of the network that need to be resolved in the near future:

- Re-dimensioning and re-engineering of a cost effective transmission transport bandwidth of the network to carry the predicted traffic generated from the actual and new services to be offered to GSM, Internet and fixed networks.

- Rationalization/consolidation of the basic network elements (switches, value-added service platforms, transmission, billing platform…) and the liberalization of the telecom sector to lead to becoming more coherent for mass deployment of new services, higher access and more efficient service management.

GLOSSARY OF ABBREVIATIONS

CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CDR	Council for Development and Reconstruction
DSLAM	Digital Subscriber Line Access Multiplexer
ISDN BRA	Integrated Service Digital Network, Basic Rate Access
ISDN PRA	Integrated Service Digital Network, Primary Rate Access
MoT	Ministry of Telecommunication
NGN	Next Generation Network
OPEX	Operational Expenditure
SDH	Synchronous Digital Hierarchy
TDM	Time Division Multiplexing
WLL	Wireless Local Loop
xDSL	Digital Subscriber Line