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H4.SMR/1132-12

SECOND ICTP - URSI - ITU/BDT SCHOOL ON THE USE OF RADIO FOR DIGITAL COMMUNICATIONS IN DEVELOPING COUNTRIES, INCLUDING SPECTRUM MANAGEMENT

(1 - 19 February, 1999)

Telecommunications needs and satisfaction of demand

Part 1: Potential market; network planning, feasibility of the business

Ing. G. Repici

ITU
Geneva
SWITZERLAND

TELECOMMUNICATIONS NEEDS AND SATISFACTION OF DEMAND

Part 1 - potential market; network planning, feasibility of the business

Synopsis. This paper provides a general overview of the Telecommunications development in terms of demand, provision of services, network implementation and economic return of the business. To account for the world trend of moving from monopolistic regulation to market competition, the logical links of the process are discussed according to the different regulation: that is to give possible references to developing countries about the expected impact of such a change. The conclusions deal with market opportunities which are opening in the medium term to the service providers.

CONTENTS

1. National situation and Telecommunication growth

The growth of telecommunication demand in a developing country depends, fundamentally, upon the national socio-economic development.The experience shows that Telecommunications have a significant dragging action in a country because they have the power to improve the way in which people communicate, exchange information or perform commercial/industrial activity. Deviation from this scheme are, mainly, due to:

Population distribution. National territory may be characterised by developed urban areas with high concentration of population and a number of underdeveloped areas scarcely populated. Under these conditions, the implementation of Telecommunications services might be concentrated in the main commercial centres leaving almost isolated the rest of the country where the provision of Telecommunications facilities turns to be generally difficult and expensive.
Dominant sector of activity. When Agriculture is the dominant sector of activity, as it is the case in many developing countries, the demand for Telecommunications is not very significant, especially if the Agriculture activity supports a mere subsistence objective rather than to be commercially oriented.
Infrastructures. Together with the lack of Telecommunications facilities, roads, electricity/water supply, transport means are scarce as well: this creates significant constraints to the development of Telecommunications in the territory, especially for isolated zones of the country.
Geography. Mountains, uneven areas, rivers, jungle, desert, islands make the country/zone difficult to serve as they are not easily accessible to the traditional transport, unsuitable to develop economic activity, and expensive to serve by Public Authority.

2. Basic estimate of demand: a simple model (Annex 1)

Consumers are expected to access Telecommunication services as a function of their income, so that the demand for Telecommunications relates to the purchasing power of the market. ~~The size of the market depends upon the prices charged to the service and, consequently, concerns the income of users~~. Under this assumption, when a potential consumer purchases the service he wants to get out the maximum advantage possible; when his income is low, it may happen that the Telecommunications services do not take great priority in his purchasing plan.
The UIT carried, long ago, a study to check the correlation between the economic development in a country and the relevant telephone penetration: the data used were derived from the statistical information supplied by the member countries. The model arrived at was of the type:

$$\text{log density} = a \times \ln(\text{GDP/capita}) - b$$

which showed a significant correlation factor thus allowing to consider the GDP/capita as one of the main explanatory indicator of Telecommunications evolution. The dependent variable "density", shown in there, should be interpreted as the total "expressed" market, that is: the ratio of main lines operated, cumulated with the waiting applications, divided by the total population.

The existence of a correlation between the telephone density and the national economic situation lets evaluate the market as a function of the evolution of the national economic situation. The demand so estimated is "potential" in the sense that it represents the actual market originated by the national economic conditions. It is, as well, "maximum" because it does not account for the possible capacity constraints of the network actually provided by the Operator.

3. GDP/capita and TPH density: a Regional survey (Graph 1;Annex 2)

On the basis of available statistics (Pyramid Research) the variables "GDP/capita" and "TPH density" have been compared (Annex A.1) by four UIT Regions over the period 1994-2003. The data include a period of actual figures and a period of estimates.

Asia Region. The Area includes 2,7 billion population in 1998. In this Region the GDP/capita is relatively low with reference to other Regions but it growths at a rate of 5,6% per year and produces an expansion of telephone service of 15,3% per year. The two variables are linked by the theoretical function:

$$\text{TPH density} = 0{,}1446 * \ln(\text{GDP/capita}) - 0{,}9464$$

which explains the development of Telephone service with an accuracy of 97,9%. The same trend is shown by the Eastern Europe Region.

Latin America. The Area includes 461 million population in 1998. The GDP/capita is relatively high with reference to other Regions nevertheless the absolute value of Telephone density is proportionately low. GDP/capita growths at the rate of 4,4 % per year while the corresponding expansion of telephone service is 10,4% per year. The two variables are linked by the theoretical a function:

$$\text{TPH density} = 0{,}3121 * \ln(\text{DP/capita}) - 2{,}4864$$

which explains the development of Telephone service with an accuracy of 97,8%.

Eastern Europe. The Area includes 292,8 millions population in 1998. The GDP/capita growths at a rate of 7,0% per year almost at the same level of the growth rate for Telephone service (6,3%). The two variables are linked by the same theoretical function found for Asia Region:

$$\text{TPH density} = 0{,}1446 * \ln(\text{GDP/capita}) - 0{,}9464$$

The accuracy of the approach is, again, 97,9% as in the case of Asia Region.

Africa/Middle East. The Area includes 226 million population in 1998. The level of GDP/capita is comparable with values found for Latin America but ~~there is no similarity between into the process of TH evolution~~. GDP/capita growths at a rate of 7,6% per year while Telephone service has a lower rate of expansion (6,4% per year). The two variables are linked by the theoretical function: (1)

$$\text{TPH density} = 0{,}3954 * \ln(\text{GDP/capita}) - 3{,}0565$$

with an accuracy of 92,4%.

4. Refining the estimate of demand

The potential demand should be further detailed to check for the market behaviour: in particular the telecommunications services to provide have to satisfy:

a public need (administrative management of country and security)
an economic need (commercial and industrial activity)
a private need (residential as final users of the facility)

(1) DOES NO PRODUCE A ~~REAL~~ PROPORTIONATE GROWTH OF TPH SERVICE

The sources of demand are, then, people involved into economic sectors of activity (active population), including government sector, and the number of families. Total active population is supposed to access telecommunications as intermediate consumption in the production process, while families nucleus use telecommunications as a final satisfaction. Active population and number of families represent the reference potential telecommunication market.

5. Socio-economic impact of Telecommunications

From a very general point of view Telecommunications provide significant impact on:

Economic activity. All national sectors of activity can get benefits out of a developed Telecommunications service either in terms of cost savings and efficient production. In particular for the Agricultural sector, when it is dominant, the information about the market request and the better contacts between sellers and buyers might improve the growing of infrastructures to support the sector and to turn the business commercially suitable.
Employment. Additional employment can be created once the activity of national sectors had expanded. Whether reliable Telecommunications are implemented to support the commercial activity at all level the whole productive sectors will find an important tool to grow up.
Internal migration. The hope of a regular earning induces people to move from isolated regions into urban zones where the economic activity may possibly give them a job and a salary. The effect of uncontrollable internal migration is to increase the demographic pressure only in some Centres where the unbalance between users and facilities makes inadequate the actual provision of basic services. The Telecommunications may help overpass this difficulty as long as they stimulate the economic development in the underdeveloped zones; together with the expansion of local employment the Telecommunications may help keeping contacts with the rest of country reducing the need of migration.
Education. Telecommunications let delivery educational programmes to far locations either through conventional support material (audio, video, conferencing, broadcasting) or through interactive access to electronic database, consultation files, library networks.
Health care. It might be a fundamental need for the population in a country. Such a benefit is more evident for the isolated zones where medical assistance and telemedicine can be given even if the main medical centre is located far away.

6. Providing the service: the natural monopoly

As long as Telecommunications have a social objective, they are a "natural" monopoly and a Government Agency is the appropriate way of providing the service over national territory.
When Government programs future national development, it establishes financing priorities among national sectors of activity, supports adequate level of employment, prevents deterioration of salaries, optimise the use of national resources, favours the improvement of national infrastructures.
In other words, it decides a number of socio-economic constraints which have to serve as guidelines for the productive sectors to plan their own expansion.
Being one of the national infrastructure, Telecommunications are, as already experienced in most countries, largely proved to have a powerful interaction with the development and the expansion of many economic sectors (Agriculture, Health, Trade, Services).
But, unlike other infrastructures, Telecommunications services involve a capital intensive activity whose socio-economic return must be measured over a long period of time. Further, especially for countries which have to import Telecommunications equipment, a great amount of capital invested might happen to be repaid in foreign currencies.
Hence, it is not always possible to place the expansion of Telecommunications service within the Government programs, either because other priorities urge or because the economic engagement may, temporarily, overpass the available allotment of funds.

However, Government would neither disregard nor neglect Telecommunications because, once the service starts deteriorating, the restoration of acceptable quality of service might turn very expensive.

7. The new scenario: the liberalisation

Once the national economy became service oriented, leaving behind the original dependence by industry and agriculture, a number of significant changes in the Sector of Communications took place which drove, inevitably, the public telecommunication system towards liberalisation. Banks, airlines, hotels, travel agencies may improve their business when they get available efficient flow of information. They become, in this way, telecommunications dependent and consequently start demanding more efficient, innovative and inexpensive communications that only liberalisation of services may provide.

7.1 - *Restructuring the public telecommunication sector*

The traditional organisation of Telecommunication sector was represented by the PTT (Post, Telegraph and Telephone) Administration where the Government owned and operated both telecommunication and postal services. The model worked well in all countries of the world but when the national socio-economic conditions changed it could no longer respond to the dynamic requirements of the market.
The first step towards liberalisation is the separation of postal and telecommunication activities with administrative and financial autonomy: the purpose is to enable the new operating entity to raise capital, to set wage rates and to enter partnerships with the private sector. Privatisation is generally the conclusion of the restructuring process. The benefit of telecommunication privatisation may differ among countries. In developing countries, for example, privatisation is more likely to generate money for the Government and to support network development. In developed countries privatisation has often been the preliminary step for the introduction of competition.

7.2 - Alliances.

At both national and trans-border levels, Europe is currently experiencing a number of mergers, acquisitions, reorganisations or other corporate entities that attempt to combine a private operator with a public network. And, as telecommunication business begins from an efficient network, the logic of entering the market is to harmonise, if possible, the need of two competitors.
Once the decision of entering the telecommunication market is taken, the Electricity and Transport Companies, which can capacity over a large backbone network, need alliance with experienced telecommunication partners. The fact that they become Capacity Providers secure to them a better deal when negotiate with a potential operating partner. The advantage is reciprocal: incumbent find in new entrants the ability to contact clients (market oriented) while the new entrants find in the incumbents the experience they do not have and the part of the network that complete their links.
Many Capacity Providers enter the telecommunication business with unrealistic expectation of quick financial return strategies and short-run recover of capital invested. Perhaps the basic mistake is to underestimate the market power and the organisation of an incumbent operator.
Indeed, there is in Europe the trend of converting some Capacity Providers into Service Providers competitors in a short time unless the same network owners can decide to become neutral capacity wholesalers to the benefit of smaller telecommunications players. There is the risk, in this way, to drive the sector into an oligopoly structure where the State may get indirect control over the competitors.

7.3 - *The EU Green Paper*

The "Green Paper" document, drafted in 1987 by the European Community, had strong influence on telecommunication sector restructuring in Europe. The main positions in the Green Paperare:

- distinction between monopoly and competitive market (provision, infrastructures);
- progressive removal of restriction on the provision of other services;

- transparency in access requirements for providers of competitive services;
- separation of regulatory and operational function of telecommunication administrations;
- support to private providers to avoid abuse of dominant position;.
- full liberalisation (1.1.98) of cross-border telecommunication.

7.4 - *The World Trade Organization (WTO)*

The WTO Basic Telecommunications Agreement opens the telecommunications markets to foreign carriers and investors in more than 60 member countries. The Agreement is based upon certain general principles and procedural rights included in two treaties, one of which is the General Agreement on Trade in Services (GATS). The GATS also has an "Annex on Telecommunications" and an "Annex on Negotiation on Basic Telecommunications". The Basic Telecommunications Agreement (BTA) was finalized in Geneva on 15.2.1997 and will take effect on 1.1.1998. A revision is planned by the year 2000. The regulatory framework for the basic telecommunications services, involves:

- competitive safeguards to prevent anti-competitive practices;
- provision of interconnection at non-discriminatory terms, conditions and rates;
- right to define the universal service obligations;
- public availability of terms and conditions of individual licenses;
- political and administrative independence of Regulatory Authority;
- Allocation and use of scarce resources (frequencies, numbers) in a transparent way.

8. Network implementation

Telecommunication business begins with a network: the larger it is the greater is the market covered, and the more dominant is the position of the owner. The network was designed and implemented long ago to meet the expected growth of voice traffic: it involved huge investment in the past as it included, under the same Provider, local, trunk and international network.

8.1 - Monopolistic Regulation (Annex 3)

Transmission systems. A transmission system includes the links between the subscribers and the local exchange (local service), between exchanges (trunk service) and between countries (international service) via an international gateway. Transmission system represent the major fixed asset of most telecommunication network Operators; because of this, the strategies for implementing transmission systems must be chosen with care by network planners.
Switching systems represent the other large network component that an Operator should use. Recent changes in switching technology are marked by three major trends:

- the adoption of digital switches to replace early electro-mechanical generations;
- modular design and manufacturing to allow increase in capacity;
- incorporation of more intelligence allowing introduction of advanced services.

Mobile communications. In its early expansion cellular radio has tended to add to rather to divert traffic from the market consumption; so that the Public Telecommunications Operators could earn additional revenue because of the additional traffic. In developing countries mobile phones are perceived as the way to overpass the difficulties given by the poor efficiency of the obsolete fixed network.
Satellite. When satellite systems were first being developed and implemented for commercial purposes, it seemed that they would solve many of the world's interconnectivity problems but they were just one of the possible technologies available for long distance and international communications; optical fibre cables developed as an attractive alternative because of its low unit costs. However, there is a return to the original plans for using satellite communications: Motorola, in fact, is managing its IRIDIUM Project for a network of low-earth orbit satellites encircling the earth and providing universal access via small portable terminals.

By available statistics (Pyramid Research 1998) it was possible to analyse the structure of the fixed telecommunications network per Region and during the period 1994-2003. Two basic indicators have been used. The first one is the ratio between the total number of trunk circuits and the total local lines operated: it measures the access to higher physical layers of network available to subscribers and, indirectly, the unit traffic capacity provided. The second indicators is the ratio between the total number of international circuits and the total local lines operated: it measures the same parameters as in the case of trunk service.

Asia Region. With reference to the year 1998, the number of trunk circuits represents about 6% of total lines operated: that means that the trunk and international traffic that 100 subscribers originate is collected by 6 circuits. The international circuits available to subscribers are, instead, 3 per 1000 lines.

Latin America. With reference to the year 1998, the number of trunk circuits represents 6,8% of total lines operated: that means that the trunk and international traffic that 100 subscribers originate is collected by 7 circuits. The international circuits available to subscribers are, instead, 6 per 1000 lines.

Eastern Europe. With reference to the year 1998, the number of trunk circuits represents 5,7% of total lines operated: that means that the trunk and international traffic that 100 subscribers originate is collected by 6 circuits. The international circuits available to subscribers are, instead, 2,5 per 1000 lines.
Africa/Middle East. With reference to the year 1998, the number of trunk circuits is 12% of total lines operated: that means that the trunk and international traffic that 100 subscribers originate is collected by 12 circuits. The international circuits available to subscribers are, instead, 4,5 per 1000 lines.

8.2 - Market competition (Annexes 4.1-4.6)

The new Operators in the market are seeking for a quick entry in the business and for a prompt return. They have, firstly, to deal with the establishment of a basic infrastructure to build up their own network but, whatever solution they find, they need interconnection with the network of dominant Operator to reach the largest possible number of users. In a deregulated market, Entities providing services like electricity or transport have, for their own use, a closed backbone telecommunication networks. If these Entities decide to enter the telecommunication market, they have already available a basic network which, by additional investments, may give them a minimum level of competition with the network of dominant Telecommunication Operator. The sectors where competition develops are:

The local plant. The use of wireless access to the subscribers at the level of local loop is a way by which new entrants with scarce network resources can connect subscribers to their nodes without using the local network of dominant Operator. Wireless Local Loop system has the enormous advantage of being provisioned within relatively short delay. In addition such a solution ensures fast installation of customers connection and a reduction in the installation and maintenance costs.
The long distance plant. The needs of new telecommunication Operators asking for interconnection and for leased capacity produce a loading change in the network of dominant Operator. Its plant, in fact, may result overcharged (interconnection) because of the additional unpredictable traffic it has to carry or may turn redundant (unused capacity) as, after the migration of part of the original market, it has to serve a lower number of customers.
The mobile service. The system makes obsolete the concept of a geographical fixed location. Such a characteristic resulted very attractive to the market so that, while cost over time decreased, the mobile phone became a mass-market commodity. After the first generation of mobile service, based on analogue wireless systems, the second generation uses digital technology that brought the advantage of:

- allocating greater number of customers into a given frequency range;
- providing better voice quality;

- introducing new services.

By available statistics (Dataquest 1997) it was possible to analyse the structure of the mobile telecommunications network per Region and during the period 1992-2001. Data refer to GSM architecture only. The network configuration is described by the ratio of subscribers per BTS (Base Transceiver Station) and by the ratios BTS/BSC (Base Station Controller) and BTS/MSC (Mobile Switching Centre). The performances of the network are measured by the traffic capacity provided over the traffic originated by users.

Asia Region. For the area covered by Hong Kong, Singapore, South Korea and Taiwan, the number of subscriber per BTS is 82 in 1998 and is expected to become 86 in 2001. In 1998 there are 103 BTS per BSC and 347 BTS per MSC: the capacity in Erlangs provided is sufficient to match the peak traffic demanded either at BTS (1,9 times) and at MSC (1,7 times) level. In the rest of Asia, the number of subscribers per BTS is 187 and is expected to become 175 in 2001. In 1998 there are 103 BTS per BSC and 354 BTS per MSC: the capacity in Erlangs provided is sufficient to match the traffic demanded either at BTS (1,8 times) and at MSC (1,7 times level.

Latin America. In this Region the mobile service started in 1997 so that the statistics available are based more upon projections than upon actual data. The number of subscriber per BTS is 60 in 1998 and is expected to keep the same in 2001. In 1998 there are 97 BTS per BSC and 373 BTS per MSC: the capacity in Erlangs provided is more than sufficient to match the traffic demanded either at BTS (2,0 times) and at MSC (1,8 times) level.

Africa/Middle East. In Africa the number of subscriber per BTS is 98 in 1998 and is expected to become 130 in 2001. In 1998 there are 113 BTS per BSC and 354 BTS per MSC: the capacity in Erlangs provided is sufficient to match the traffic demanded either at BTS (2,0 times) and at MSC (1,7 times). In the Middle East region the number of subscribers per BTS is 58 in 1998 and is expected to become 70 in 2001. There are 100 BTS per BSC and 340 BTS per MSC: the capacity in Erlangs provided is sufficient to match the traffic demanded either at BTS (2,1 times) and at MSC (1,8 times).

Central & Eastern Europe. The number of subscriber per BTS is 103 in 1998 and is expected to become 137 in 2001. In 1998 there are 99 BTS per BSC and 343 BTS per MSC: the capacity in Erlangs provided is sufficient to match the traffic demanded either at BTS (1,7 times) and at MSC (1,6 times).

9. The investment in Telecommunications

Unit investment per line (annual investment/new line installed) have been estimated from available statistics by Region and for the period 1994-2003. Details are provided as investment are separated into: Switching, Transmission Outside Plant, and other equipment: absolute value of unit cost and its trend over time are given in Annex A to B.

9.1 - Fixed network (Annex 5)

Asia. The Area shows the highest unit cost among the Regions. The trend of unit investment per line is decreasing all over the period under study; from a value of 1682 US$/line in 1994 the investment is expect to become 1220 US$/line in 2003 with an average reduction of 3,5% per year.

Latin America. The trend of unit investment per line is decreasing all over the period under study; from a value of 1380 US$/line in 1994 the investment is expect to become 1028 US$/line in 2003 with an average reduction of 3,2% per year.

Eastern Europe. The trend of unit investment per line is decreasing all over the period under study; from a value of 1086 US$/line in 1994 the investment is expect to become 905 US$/line in 2003 with an average reduction of 2,0% per year.

Africa/Middle East. The Area shows the lowest unit cost among the Regions. The trend of unit investment per line is decreasing all over the period under study; from a value of 942 US$/line in 1994 the investment is expect to become 769 US$/line in 2003 with an average reduction of 2,2% per year.

9.2 - Mobile network (Annexes 6.1-6.3)

Asia. In the Area involving Hong Kong, Singapore, South Korea and Taiwan investment increase at an average rate of 58,6% per year during 8 years study: the subscribers connected are supposed to double during the same period. The unit investment decrease over time at an average rate of 20,2% per year, as it moves from 3720 US$/line in 1993 to 609,3 US$/line in 2001. In the rest of Asia investment increase at an average rate of 115% per year during a period of 7 years (1994-2001): the subscribers connected are supposed to increase by 170% during the same period. The unit investment decrease over time at the rate of 20,9% per year moving from 1658,4 US$/line in 1994 to 320 US$/line in 2001.

Latin America. Insufficient number of statistics, since the service started in 1997, does not let consider significant comments. In four years (1997-2001) investment increase at the average rate of 65,7% per year and produce an increase in the line installed of 85% per year. The unit investment decrease over time at the rate of 10,6% per year moving from 1475,5 US$/line in 1997 to 941,1 US$/line in 2001.

Africa/Middle East. Total investment in Africa increase at an average rate of 50% per year during a period of 7 years (1994-2001): subscribers connected increase, within the same period, by 63,5% per year. Unit investment decrease over time (1994-2001) at an average rate of 8,3% per year varying from 866 US$/line in 1994 to 471 US$/line in 2001. In Middle East total investment increase at an average rate of 56,1% per year during 1995-2001: the corresponding subscribers increase by 72,5% per year. Unit investment decrease at a rate of 9,5% per year moving from 1479,4 US$/line in 1995 to 812,8 US$/line in 2001.

Central &Eastern Europe. Total investment in the Region increase at an average rate of 72,2% per year during a period of 7 years (1994-2001): subscribers connected increase, within the same period, by 116% per year. Unit investment decrease over time (1994-2001) at an average rate of 20,6% per year varying from 2084,1 US$/line in 1994 to 415,6 US$/line in 2001.

10. The telecommunication revenue

The same source of statistics let collect total revenue over time and per Region; some of historical data result in the source show unexpected trends so that the confidence to give to the actual data and especially to the forecast should be accepted with prudence as they may not have high degree of confidence. For the fixed network revenue are divided into local, trunk and international income: the same separation was used into the Annexes. Revenue from mobile users cannot have the same separation but rather they are separated into revenue at local level, revenue at long distance and fixed revenue (contracts, subscriptions, others).

10.1 – Fixed network (Annex 7)

Asia. Local revenue are expected to increase at an average rate of 15,7% per year during 1994-2003. Unit revenue per line starts at a level 0f 146 US$ per year, then drop at 108 US$ per year: it is expected to recover previous value by 2003. Trunk revenue are supposed to increase at an average rate of 17,7% per year during 1994-2003. Unit revenue follow the same pattern remarked in case of local service: starts at 148 US$ in 1994, drops at 102 US$ in 1998, raises up at 160 US$ in 2003. Interna-

tional revenue increase at an average rate of 9,6% per year during 1994-2003. Unit national revenue, as an average, regularly decreases (-6,2% per year) over the period 1994-2003.
As a final result, total unit revenue (local + trunk + international) slightly decreases (-1,8% per year) over the period (1994-2003) under analysis.

Latin America. Local revenue increase at an average rate of 19,8% per year during 1994-2003: this exceptional growth is mainly due to the forecasts for the period 1999-2003. Unit revenue per line increase all over almost regularly (6,7%) moving from 195 US$ per year in 1994 to 349 US$ per year in 2003. Trunk revenue increase at an average rate of 4,4% per year during 1994-2003: still the significant jump is expected after 1999. Unit trunk revenue decreases all over the period (-6,9% per year). Same situation is remarked for international revenue that increase at an average rate of 3,5% per year during 1994-2003 while, over the same period, unit international revenue decrease regularly (7,8% per year).
As a final result, total unit revenue (local + trunk + international) keeps almost constant (-0,2% per year) over the period (1994-2003) under analysis.

Eastern Europe. Local revenue increase at an average rate of 24,1% per year during 1994-2003: again an exceptional growth mainly due to the forecasts for the period 1999-2003. Unit revenue per line increase, as well, all over the period by 17,0% moving from 62 US$ per year in 1994 to 254 US$ per year in 2003. Trunk revenue significantly increase at an average rate of 12,8% per year during 1994-2003: still the significant jump is expected after 1999. Unit trunk revenue increases all over the period (6,4% per year). Same situation shows up for international revenue that increase at an average rate of 19,0% per year during 1994-2003: unit international revenue increases regularly by 12,3% per year over the same period.
As a final result, total unit revenue (local + trunk + international) increases at 11,0% per year over the period (1994-2003) under analysis.

Africa/Middle East. Local revenue increase at an average rate of 7,0% per year during 1994-2003. Unit revenue per line decreases at an average rate of 1,3% going form 162 US$ year in 1994 to143, US$ per year in 2003. Trunk revenue almost double during 1994-2003 growing at an average rate of 7,0% per year. The corresponding unit revenue decreases at a rate of 1,4 % per year during the same period. International revenue increase at an average rate of 7,5% per year during 1994-2003 passing from 2400 millions US$ up to 4600 millions US$. International unit revenue slightly decreases (-0,9% per year) over the period.
As a final result, total unit revenue (local + trunk + international) slightly decreases (-1,3% per year) over the period (1994-2003) under analysis.

10.2 - Mobile network (Annexes 8.1-8.2)

According to the statistics available (Dataquest 1997) revenue are separated into three categories: revenue at BSS (Base Station System) level, at MSC (Mobile Switching Centre) level and at a fixed amount (contract revenue). Revenue refer to the period 1994-2001 where 5 out of the 10 years of the study are projections; so that figures shown must be taken with prudence.

Asia. In the Area covered by Hong Kong, Singapore, South Korea and Taiwan, total revenue increase at an average rate of 32,9% per year during 1993-2001; within the same period, the unit revenue decreases from 3694,1 US$/line in 1993 to 147,0 US$/line in 2001 (-33,2% per year). For the rest of Asia total revenue increase at an average rate of 81,7% per year during 1994-2001; in the same period the unit revenue decreases from 1849,0 US$/line in 1994 to 108,9 US$/line in 2001 (-33,2% per year).

Eastern Europe. Total revenue increase at an average rate of 81,7% per year during 1994-2001; in the same period the unit revenue decreases from 2240,7 US$/line in 1994 to 181,2 US$/line in 2001 (-33,2% per year).

Africa/Middle East. In Africa total revenue increase at an average rate of 13,0% per year during 1994-2001; in the same period the unit revenue decreases from 1057,1 US$/line in 1994 to 79,5 US$/line in 2001 (-30,9% per year). Middle East is characterised by an increase of total revenue of 64,5% per year from 1994 to 2001: in the same period the unit revenue decreases from 1859,5 US$/line in 1994 to 226,8 US$/line in 2001 (-26,0% per year).

Latin America. As the service started in 1997, data for Latin America are mainly expectations since three over the 5 years study are estimates. Total revenue are supposed to increase by 30,6% per year from 1997 to 2001: in the same period, unit revenue decreases from 1859,5 US$/line in 1997 to 358,5 US$/line in 2001 (-29,6% per year).

11. The feasibility of business

The feasibility of telecommunications service is measured by the ratio:

Average Return = (Revenue-Expenses)/Investment

which must be compared to current the rate of interest. The indicator is calculated with reference to unit values: revenue, investment and expenses relate, then, to the single line; out of the three financial elements in the formula only expenses are unknown and unavailable. To complete the exercise the working hypothesis has been assumed that annual expenses (capital recovery + operating cost + interests) can be derived as 25% of corresponding investment. Consequently, the final results arrived at may not produce any actual situation but are rather to be considered as representative of a general trend.

11.1 – Fixed network (Annex 9)

Asia. The trend of the indicator (Return) follows the same pattern already remarked in the unit revenue: it shows an inflexion during 1998-2000and is expected to raise up to 6,% in 2003. The final result should have been more interesting (+11,5% in 2001) if annual expenses had been assumed as 20% of investment only.

In **Latin America, Eastern Europe** and **Africa/Middle East** the rate of return calculated under the working hypothesis made in the premises shows a reasonable level so that, in these regions, the telecommunications service might be declared feasible.

11.2 – Mobile network (Annexes 10.1-10.2)

The general trend coming out of the exercise is that while the return keeps reasonable values up to 1998 the following values until 2001 show a progressive deterioration driving the system to very low returns if not negatives. As it was already said, since annual expenses are estimated and there exist no reference whatsoever to understand the pattern of this element, no firm conclusion can be derived from the exercise except the information that the return of mobile service is expected to decrease over time.

12. Conclusions

From the general analysis previously made, the following conclusions can be retained.
Technical choices. Emphasis was given to the fact that local factors, carefully analysed, should guide the selection of infrastructures and of technology as a pure technical issue. A final recommendation

would, then, be of framing into the present and expected situation (actual needs; expansion of systems) the choice of equipment, suppliers and technology.

The infrastructures. Among the constraints which make difficult the start of wireless systems, the main issue recalled is the absence of infrastructures (transport, energy supply) in the isolated zones of a country. The expansion of the Telecommunications outside the main commercial and economic centers can be obtained in the medium run through an accurate planning.

The economic return. It was, as well, pointed out that one of the critical issue, in the development of wireless systems, is that because of the cost and of the relatively poor market addressed (rural and underdeveloped areas) the service does not produce sufficient return. For the feasibility of such projects one possible solutions is to adopt subsidization among categories of users (Business, Residential) and/or among services (local, trunk, international) by artificial cost share. Alternatively, the subscribers may be called to contribute to finance the service in the rural areas; or the Telecommunications service might, when possible, be developing for the business sector first and then expanded to residential sector.

Liberalization. An anticipated move to liberalization may attract, when accompanied by a correct planning, capital to invest into the expansion of Telecommunications services and the modernization of the existing network. Fundamental, in this respect, is the appointment of a Regulatory Entity in a position to fix a clear set of rules (interconnection, disputes) to favor competition.

Direct foreign investment. The issue is critical in the sense that the partner would, not only, have the objective of deriving the maximum profit possible from their commitment but also it may try to drive a limited project to coincide with national plan. Foreign investors are sensitive to:

- little political/economic risks
- a stable legal and commercial environment
- a profitable market for their service offering

NATIONAL SITUATION & TELECOMMUNICATION GROWTH

Analysis of regional demand

Evolution of economic situation (GDP/capita) and telephone expansion

1. Asia Region

Years study	GDP/capita in US $	Lines 000's	Population 000's	Telephone density
1994	827,0	77258	2593876	2,98%
1995	962,1	96317	2632023	3,66%
1996	1046,9	118568	2667998	4,44%
1997	1053,6	141279	2703931	5,22%
1998	943,0	165214	2740040	6,03%
1999	997,7	191208	2776302	6,89%
2000	1081,9	219901	2812144	7,82%
2001	1204,6	249991	2846412	8,78%
2002	1316,9	281358	2893824	9,72%
2003	1351,1	312955	2924214	10,70%

2. Latin America

Years study	GDP/capita in US $	Lines 000's	Population 000's	Telephone density
1994	3670,1	37041	431280	8,59%
1995	3777,8	40498	438780	9,23%
1996	3964,2	44450	446136	9,96%
1997	4282,9	49740	453734	10,96%
1998	4349,4	55414	461367	12,01%
1999	4446,4	62457	469106	13,31%
2000	4849,7	72823	476895	15,27%
2001	5049,4	84860	484820	17,50%
2002	5289,6	95592	492801	19,40%
2003	5389,2	104631	500025	20,93%

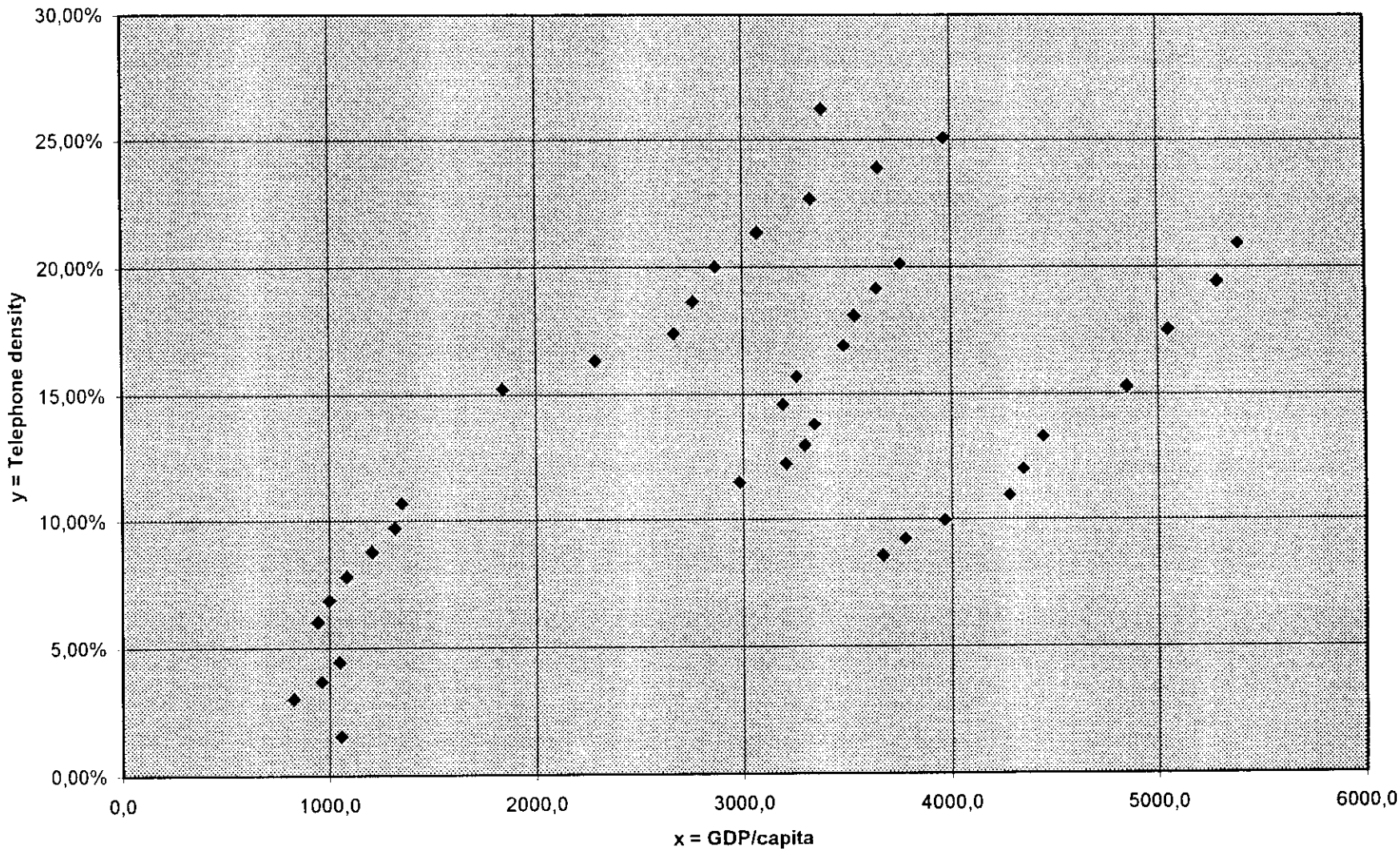
3. Eastern Europe

Years study	GDP/capita in US $	Lines 000's	Population 000's	Telephone density
1994	1841,4	45016	295880	15,21%
1995	2285,5	48142	295401	16,30%
1996	2666,3	51069	294335	17,35%
1997	2757,8	54639	293356	18,63%
1998	2869,1	58580	292860	20,00%
1999	3072,2	62400	292403	21,34%
2000	3332,9	66185	291961	22,67%
2001	3652,8	69643	291555	23,89%
2002	3969,3	72996	291155	25,07%
2003	3388,3	76225	290490	26,24%

4. Africa/Middle East

Years study	GDP/capita in US $	Lines 000's	Population 000's	Telephone density
1994	2982,8	23858	207608	11,49%
1995	3206,6	25810	210934	12,24%
1996	3300,5	28052	216309	12,97%
1997	3347,6	30458	220706	13,80%
1998	3193,3	32986	226138	14,59%
1999	3262,1	36033	229690	15,69%
2000	3486,9	39490	234154	16,86%
2001	3538,7	43084	238740	18,05%
2002	3642,8	46536	243396	19,12%
2003	5760,6	49505	246156	20,11%

GRAPH 1



demand/Grafico1

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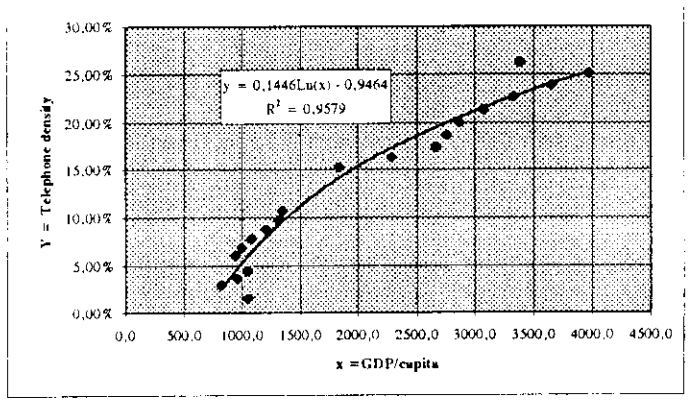
TELEPHONE DENSITY AND GDP/CAPITA

Theoretical approach to the correlation function

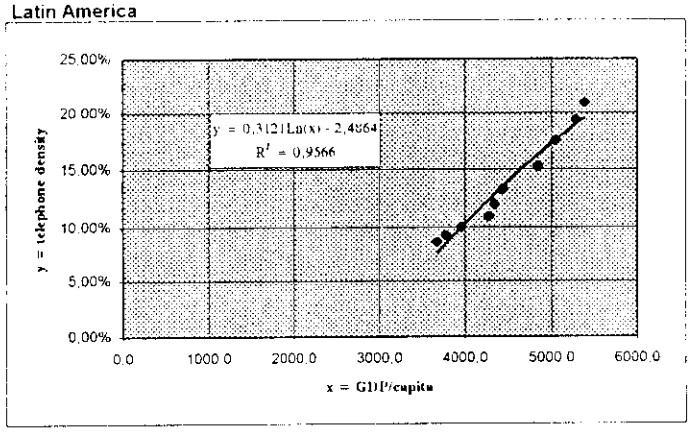
Developing countries
Data from Annex 1

GDP per capita	Actual density	Density estimate
827,0	2,98%	2,50%
962,1	3,66%	4,69%
1046,9	4,44%	5,91%
1053,6	1,53%	6,00%
943,0	6,03%	4,40%
997,7	6,89%	5,21%
1081,9	7,82%	6,38%
1204,6	8,78%	7,94%
1316,9	9,72%	9,23%
1351,1	10,70%	9,60%
1841,4	15,21%	14,07%
2285,5	16,30%	17,20%
2666,3	17,35%	19,43%
2757,8	18,63%	19,91%
2869,1	20,00%	20,49%
3072,2	21,34%	21,48%
3332,9	22,67%	22,65%
3652,8	23,89%	23,98%
3969,3	25,07%	25,18%
3388,3	26,24%	22,89%
3670,1	8,59%	7,53%
3777,8	9,23%	8,43%
3964,2	9,96%	9,94%
4282,9	10,96%	12,35%
4349,4	12,01%	12,83%
4446,4	13,31%	13,52%
4849,7	15,27%	16,23%
5049,4	17,50%	17,49%
5289,6	19,40%	18,94%
5389,2	20,93%	19,52%
2982,8	11,49%	10,69%
3206,6	12,24%	13,56%
3300,5	12,97%	14,70%
3347,6	13,80%	15,26%
3193,3	14,59%	13,39%
3262,1	15,69%	14,23%
3486,9	16,86%	16,87%
3538,7	18,05%	17,45%
3642,8	19,12%	18,60%
3760,6	20,11%	19,86%

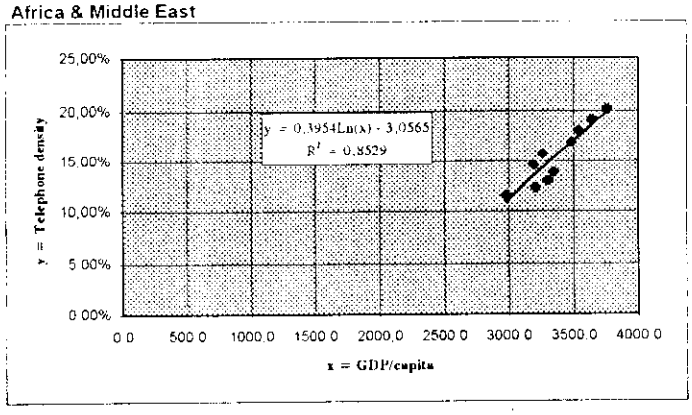
Asia & Eastern Europe



Latin America



Africa & Middle East



MAIN STRUCTURE OF FIXED NETWORK

Design and main ratios

1. Asia Region

years of study	local lines	trunk circuits	First ratio	internat circuits	Second ratio
1994	110261	6560	5,95%	378	0,34%
1995	138720	8853	6,38%	490	0,35%
1996	174605	10614	6,08%	530	0,30%
1997	199880	11719	5,86%	640	0,32%
1998	226104	13396	5,92%	669	0,30%
1999	255970	15156	5,92%	801	0,31%
2000	289032	17461	6,04%	988	0,34%
2001	324204	19743	6,09%	1141	0,35%
2002	360296	22523	6,25%	1303	0,36%
2003	397803	25425	6,39%	1497	0,38%

2. Latin America Region

years of study	local lines	trunk circuits	First ratio	internat circuits	Second ratio
1994	40990	2835	6,92%	214	0,52%
1995	45714	3146	6,88%	255	0,56%
1996	50854	3456	6,80%	295	0,58%
1997	56212	3849	6,85%	336	0,60%
1998	63141	4312	6,83%	375	0,59%
1999	71450	5168	7,23%	403	0,56%
2000	83200	6312	7,59%	472	0,57%
2001	96833	7566	7,81%	555	0,57%
2002	108798	8790	8,08%	625	0,57%
2003	118657	9893	8,34%	685	0,58%

3. Eastern Europe Region

years of study	local lines	trunk circuits	First ratio	internat circuits	Second ratio
1994	50418	2561	5,08%	98	0,19%
1995	53166	2815	5,29%	117	0,22%
1996	56980	3133	5,50%	136	0,24%
1997	61319	3483	5,68%	150	0,24%
1998	67505	3821	5,66%	168	0,25%
1999	72536	4298	5,93%	187	0,26%
2000	77225	4744	6,14%	207	0,27%
2001	81266	5120	6,30%	228	0,28%
2002	85031	5431	6,39%	245	0,29%
2003	88587	5727	6,46%	257	0,29%

4. Africa $ Middle East Region

years of study	local lines	trunk circuits	First ratio	intern circuits	Second ratio
1994	24501	2789	11,38%	82	0,33%
1995	25900	3086	11,92%	89	0,34%
1996	28474	3388	11,90%	98	0,34%
1997	31135	3729	11,98%	130	0,42%
1998	33542	4024	12,00%	152	0,45%
1999	36688	4474	12,19%	179	0,49%
2000	40153	4978	12,40%	197	0,49%
2001	43689	5516	12,63%	218	0,50%
2002	47039	5957	12,66%	242	0,51%
2003	50623	6386	12,61%	268	0,53%

STRUCTURE AND PERFORMANCES OF CELLULAR NETWORK

Asia 1 : Hong Kong, Singapore, South Korea, Taiwan

Regional network basic structure

Years	Subscribers 000	BTS 000	number of BSC	number of MSC	transit MSC
1992	0,0	0,0	0,0	0	0
1993	30,4	0,8	7,7	3	0
1994	218,0	3,1	30,3	11	0
1995	680,4	8,8	84,2	29	1
1996	1544,0	17,7	169,8	55	3
1997	2485,6	28,5	274,1	87	8
1998	3403,2	41,3	401,7	119	16
1999	4530,4	54,9	527,3	151	27
2000	5843,6	69,9	676,3	185	43
2001	7427,4	86,1	823,1	218	50

Network performances (traffic flow)

Years	Lines operated 000	Peak traffic erlangs	BTS channels 000	BTS capacity Erlangs	MSC capacity Erlangs
1992	0,0	0,0	0,0	0,0	0,0
1993	30,4	1,2	7,2	5,4	6,5
1994	218,0	8,5	28,6	21,7	23,6
1995	680,4	26,3	80,9	61,5	62,7
1996	1544,0	58,2	179,9	123,7	115,8
1997	2485,6	101,6	347,5	202,0	187,0
1998	3403,2	156,5	685,3	298,8	273,6
1999	4530,4	219,4	1339,1	406,4	368,4
2000	5843,6	290,9	2588,3	528,1	473,8
2001	7427,4	367,1	5112,4	659,7	585,9

STRUCTURE AND PERFORMANCES OF CELLULAR NETWORK

Asia 2: rest of Asia

Regional network basic structure

Years	Subscribers 000	BTS 000	number of BSC	number of MSC	transit MSC
1992	0,0	0,0	0,0	0	0
1993	0,0	0,0	0,0	0	0
1994	84,1	1,1	10,7	4	0
1995	667,5	8,1	77,5	27	1
1996	4123,3	20,9	200,5	66	4
1997	12837,4	58,5	562,7	178	17
1998	22834,3	122,2	1188,5	345	46
1999	37429,1	231,5	2223,3	610	110
2000	60702,8	366,0	3540,9	907	209
2001	93391,4	533,5	5100,4	1250	288

Network performances (traffic flow)

Years	Lines operated 000	Peak traffic erlangs	BTS channels 000	BTS capacity Erlangs	MSC capacity Erlangs
1992	0,0	0,0	0,0	0,0	0,0
1993	0,0	0,0	0,0	0,0	0,0
1994	84,1	3,1	12,3	7,9	8,6
1995	667,5	24,2	89,2	56,7	57,7
1996	4123,3	69,7	477,2	146,6	138,7
1997	12837,4	210,5	1618,5	409,7	383,3
1998	22834,3	462,8	3798,8	855,6	792,2
1999	37429,1	912,9	8531,9	1620,3	1484,6
2000	60702,8	1488,1	20194,2	2562,0	2323,3
2001	93391,4	2213,6	46698,2	3734,8	3352,2

STRUCTURE AND PERFORMANCES OF CELLULAR NETWORK

Central and Eastern Europe

Regional network installed structure

Years	Subscribers 000	BTS 000	number of BSC	number of MSC	transit MSC
1992	0,0	0,0	0,0	0	0
1993	0,1	0,0	0,0	0	0
1994	81,0	1,3	12,8	5	0
1995	248,2	3,6	35,3	12	1
1996	825,0	10,1	99,5	33	2
1997	2128,6	22,9	227,0	72	7
1998	4280,3	41,6	418,7	121	16
1999	7519,4	66,0	658,9	184	33
2000	12158,8	96,7	975,9	261	60
2001	18269,8	133,4	1336,5	365	84

Network performances (traffic flow)

Years	Lines operated 000	Peak traffic erlangs	BTS channels 000	BTS capacity Erlangs	MSC capacity Erlangs
1992	0,0	0,0	0,0	0,0	0,0
1993	0,1	0,0	0,0	0,0	0,0
1994	81,0	3,6	10,5	9,2	10,0
1995	248,2	10,8	28,8	25,2	25,6
1996	825,0	34,1	81,1	71,0	67,9
1997	2128,6	84,3	183,4	160,4	153,5
1998	4280,3	162,7	332,7	291,1	278,4
1999	7519,4	275,0	533,5	467,5	447,2
2000	12158,8	429,0	796,8	700,1	669,7
2001	18269,8	623,6	1120,6	987,2	978,4

STRUCTURE AND PERFORMANCES OF CELLULAR NETWORK

Africa

Regional network basic structure

Years	Subscribers 000	BTS 000	number of BSC	number of MSC	transit MSC
1992	0,0	0,0	0,0	0	0
1993	0,0	0,0	0,0	0	0
1994	217,3	1,3	11,7	5	0
1995	527,2	3,9	34,9	13	1
1996	908,0	6,4	57,0	20	1
1997	1654,8	15,8	139,9	47	4
1998	2740,0	28,0	248,8	79	11
1999	3942,5	38,9	353,4	104	19
2000	5266,1	46,4	422,9	118	27
2001	6811,7	52,2	467,8	127	29

Network performances (traffic flow)

Years	Lines operated 000	Peak traffic erlangs	BTS channels 000	BTS capacity Erlangs	MSC capacity Erlangs
1992	0,0	0,0	0,0	0,0	0,0
1993	0,0	0,0	0,0	0,0	0,0
1994	217,3	3,6	10,6	9,3	10,1
1995	527,2	11,8	31,5	27,5	28,1
1996	908,0	20,9	51,4	44,9	41,6
1997	1654,8	55,2	128,0	112,2	101,6
1998	2740,0	103,3	230,5	202,5	180,6
1999	3942,5	150,3	326,4	287,5	252,4
2000	5266,1	186,4	397,5	351,0	303,5
2001	6811,7	213,5	452,4	400,2	340,8

STRUCTURE AND PERFORMANCES OF CELLULAR NETWORK

Middle East

Regional network basic structure

Years	Subscribers 000	BTS 000	number of BSC	number of MSC	transit MSC
1992	0,0	0,0	0,0	0	0
1993	0,0	0,0	0,0	0	0
1994	24,2	0,3	3,0	1	0
1995	248,9	3,3	33,7	11	1
1996	759,7	9,9	99,6	31	2
1997	1200,3	21,3	216,4	65	6
1998	2045,3	35,4	353,6	104	14
1999	3326,0	54,4	560,8	154	28
2000	4884,2	74,0	741,6	202	47
2001	6563,1	93,8	932,7	248	57

Network performances (traffic flow)

Years	Lines operated 000	Peak traffic erlangs	BTS channels 000	BTS capacity Erlangs	MSC capacity Erlangs
1992	0,0	0,0	0,0	0,0	0,0
1993	0,0	0,0	0,0	0,0	0,0
1994	24,2	0,9	2,6	2,3	2,5
1995	248,9	9,9	26,6	23,2	23,7
1996	759,7	32,7	79,6	69,6	65,2
1997	1200,3	74,9	170,2	149,0	140,9
1998	2045,3	131,3	286,2	250,8	239,6
1999	3326,0	209,0	441,5	387,1	373,6
2000	4884,2	292,1	604,2	530,1	516,9
2001	6563,1	375,9	769,2	675,4	665,3

ESTIMATE OF COST FOR CELLULAR NETWORK

Estimate cost of regional network (unit cost) Asia 1

Years	Subscribers 000	Cost of BTS millions US$	Cost of BSC milions US $	Cost of BSS millions US$	Cost of MSC millions US $	Total cost millions US$	Unit cost US $
1992	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1993	30,4	44,3	7,5	54,0	7,3	113,1	3718,9
1994	218,0	146,0	25,3	178,3	27,1	376,7	1728,0
1995	680,4	352,0	60,9	431,2	66,1	910,1	1337,6
1996	1544,0	601,8	106,8	741,6	120,6	1570,8	1017,3
1997	2485,6	852,2	151,7	1048,8	178,1	2230,7	897,4
1998	3403,2	1098,6	197,8	1354,6	227,3	2878,3	845,8
1999	4530,4	1317,6	233,8	1619,6	270,7	3441,6	759,7
2000	5843,6	1523,8	272,8	1880,3	309,2	3986,2	682,1
2001	7427,4	1730,6	305,5	2126,7	362,9	4525,6	609,3

Estimate cost of regional network (unit cost) Asia 2

Years	Subscribers 000	Cost of BTS millions US$	Cost of BSC milions US $	Cost of BSS millions US$	Cost of MSC millions US $	Total cost millions US$	Unit cost US $
1992	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1994	84,1	54,6	8,9	66,0	10,0	139,5	1658,4
1995	667,5	341,0	56,0	414,7	62,1	873,8	1309,1
1996	4123,3	748,2	126,1	913,3	184,2	1971,8	478,2
1997	12837,4	1866,2	311,4	2269,8	489,3	4936,6	384,5
1998	22834,3	3470,5	585,3	4215,9	852,1	9123,8	399,6
1999	37429,1	5903,3	985,6	7199,7	1357,2	15445,7	412,7
2000	60702,8	8491,2	1428,4	10357,8	1923,5	22200,9	365,7
2001	93391,4	11416,9	1892,8	13871,0	2679,9	29860,5	319,7

ESTIMATE OF COST FOR CELLULAR NETWORK

Estimate cost of regional network (unit cost) Middle East

Years	Subscribers 000	Cost of BTS millions US$	Cost of BSC milions US $	Cost of BSS millions US$	Cost of MSC millions US $	Total cost millions US$	Unit cost US $
1992	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1994	24,2	15,2	2,6	18,5	2,8	39,1	1617,4
1995	248,9	142,6	25,1	173,3	27,3	368,2	1479,4
1996	759,7	363,3	64,5	443,5	72,8	944,2	1242,9
1997	1200,3	696,5	123,3	847,7	136,7	1804,3	1503,2
1998	2045,3	1030,1	179,4	1242,5	207,2	2659,3	1300,2
1999	3326,0	1425,3	256,1	1735,4	291,1	3707,8	1114,8
2000	4884,2	1761,2	308,1	2146,0	362,4	4577,7	937,3
2001	6563,1	2054,2	356,6	2504,5	419,0	5334,3	812,8

Estimate cost of regional network (unit cost) Africa

Years	Subscribers 000	Cost of BTS millions US$	Cost of BSC milions US $	Cost of BSS millions US$	Cost of MSC millions US $	Total cost millions US$	Unit cost US $
1992	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1994	217,3	72,2	9,6	85,5	20,9	188,2	866,0
1995	527,2	184,1	24,8	218,8	39,6	467,3	886,3
1996	908,0	256,6	35,2	305,9	56,7	654,5	720,9
1997	1654,8	570,4	76,1	677,8	117,0	1441,3	871,0
1998	2740,0	898,8	120,4	1069,6	184,0	2272,9	829,5
1999	3942,5	1124,2	154,0	1338,2	232,2	2848,5	722,5
2000	5266,1	1220,3	167,7	1452,3	256,7	3097,0	588,1
2001	6811,7	1263,2	170,6	1503,4	270,9	3208,1	471,0

ESTIMATE OF COST FOR CELLULAR NETWORK

Estimate cost of regional network (unit cost) Eastern Europe

Years	Subscribers 000	Cost of BTS millions US$	Cost of BSC milions US $	Cost of BSS millions US$	Cost of MSC millions US $	Total cost millions US$	Unit cost US $
1992	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1993	0,1	0,0	0,0	0,0	0,0	0,0	21,8
1994	81,0	66,2	10,9	80,0	11,8	168,8	2084,1
1995	248,2	155,9	28,3	185,4	27,9	397,4	1601,1
1996	825,0	371,7	63,4	452,5	73,6	961,1	1165,0
1997	2128,6	742,0	127,2	902,3	155,4	1926,9	905,2
1998	4280,3	1198,1	208,8	1460,2	255,2	3122,2	729,4
1999	7519,4	1709,4	295,7	2079,0	375,2	4459,3	593,0
2000	12158,8	2282,1	398,6	2775,3	511,4	5967,3	490,8
2001	18269,8	2894,8	502,1	3521,8	674,8	7593,5	415,6

Estimate cost of regional network (unit cost) Latin America

Years	Subscribers 000	Cost of BTS millions US$	Cost of BSC milions US $	Cost of BSS millions US$	Cost of MSC millions US $	Total cost millions US$	Unit cost US $
1992	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1994	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1995	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1996	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1997	115,9	66,2	12,1	80,8	11,9	171,0	1475,8
1998	336,4	165,2	29,9	201,0	28,9	425,0	1263,3
1999	659,2	276,6	49,7	335,9	49,0	711,3	1079,0
2000	1028,2	389,6	71,1	473,3	66,6	1000,7	973,2
2001	1368,0	501,7	91,5	612,5	81,7	1287,4	941,1

FIXED NETWORK: TOTAL AND UNIT REVENUE

1. Asia Region

Years of study	Lines operated	Local revenue		Trunk revenue		International revenue		Total
		million US$	US$/line	million US$	US$/line	million US$	US$/line	US$/line
1994	77258	11284	146,1	11469	148,5	12351	159,9	454,4
1995	96317	13843	143,7	14083	146,2	14272	148,2	438,1
1996	118588	16291	137,4	16245	137,0	15078	127,1	401,5
1997	141279	17888	126,6	16858	119,3	14500	102,6	348,6
1998	165214	17323	104,9	16816	101,8	14101	85,3	292,0
1999	191208	20668	108,1	20694	108,2	16384	85,7	302,0
2000	219901	25156	114,4	26014	118,3	18344	83,4	316,1
2001	249991	30923	123,7	31539	126,2	21214	84,9	334,7
2002	281358	36244	128,8	40335	143,4	24493	87,1	359,2
2003	312955	42013	134,2	50117	160,1	28165	90,0	384,4

2. Latin America

Years of study	Lines operated	Local revenue		Trunk revenue		International revenue		Total
		million US$	US$/line	million US$	US$/line	million US$	US$/line	US$/line
1994	37041	7204	194,5	8673	234,1	3722	100,5	529,1
1995	40498	7112	175,6	9030	223,0	3374	83,3	481,9
1996	44450	9660	217,3	9469	213,0	3541	79,7	510,0
1997	49740	13364	268,7	9223	185,4	3241	65,2	519,3
1998	55414	14782	266,8	9732	175,6	3443	62,1	504,5
1999	62457	17313	277,2	9883	158,2	3500	56,0	491,5
2000	72823	21003	288,4	10565	145,1	3704	50,9	484,4
2001	84860	26084	307,4	11057	130,3	4145	48,8	486,5
2002	95592	31923	334,0	12079	126,4	4655	48,7	509,0
2003	104631	36533	349,2	12801	122,3	5051	48,3	519,8

3. Eastern Europe Region

Years of study	Lines operated	Local revenue		Trunk revenue		International revenue		Total
		million US$	US$/line	million US$	US$/line	million US$	US$/line	US$/line
1994	45016	2772	61,6	5774	128,3	1932	42,9	232,8
1995	48142	4567	94,9	7092	147,3	2740	56,9	299,1
1996	51069	5038	98,7	8470	165,9	3242	63,5	328,0
1997	54639	5591	102,3	10223	187,1	3689	67,5	356,9
1998	58580	6824	116,5	11438	195,3	4319	73,7	385,5
1999	62400	8043	128,9	12226	195,9	5083	81,5	406,3
2000	66185	10050	151,8	13177	199,1	5916	89,4	440,3
2001	69643	12556	180,3	14352	206,1	6897	99,0	485,4
2002	72996	15544	212,9	15666	214,6	8006	109,7	537,2
2003	76225	19330	253,6	17014	223,2	9270	121,6	598,4

4. Africa & Middle East region

Years of study	Lines operated	Local revenue		Trunk revenue		International revenue		Total
		million US$	US$/line	million US$	US$/line	million US$	US$/line	US$/line
1994	23858	3861	161,8	3801	159,3	2407	100,9	422,0
1995	25810	4090	158,5	3696	143,2	2693	104,3	406,0
1996	28052	4054	144,5	3838	136,8	2808	100,1	381,4
1997	30458	4284	140,7	4234	139,0	3114	102,2	381,9
1998	32986	4359	132,1	4855	147,2	3196	96,9	376,2
1999	36033	4775	132,5	5136	142,5	3500	97,1	372,2
2000	39490	5312	134,5	5470	138,5	3805	96,4	369,4
2001	43084	5858	136,0	5921	137,4	4092	95,0	368,4
2002	46536	6431	138,2	6355	136,6	4336	93,2	367,9
2003	49505	7103	143,5	6920	139,8	4606	93,0	376,3

GSM MOBILE NETWORK: TOTAL AND UNIT REVENUE 1

1. Asia 1

Years	Subscribers	BSS revenue		MSC revenue		Contract revenue		Total
of study	000	million US$	US$/line	million US$	US$/line	million US$	US$/line	US$/line
1992	0,0	0	0,0	0	0,0	0	0,0	0,0
1993	30,4	52,1	1713,8	26,5	871,7	33,7	1108,6	3694,1
1994	218,0	134	614,7	66,3	304,1	85,9	394,0	1312,8
1995	680,4	278,7	409,6	143,5	210,9	198,7	292,0	912,6
1996	1544,0	372,1	241,0	196,5	127,3	267,6	173,3	541,6
1997	2485,6	400,2	161,0	231,8	93,3	297,4	119,6	373,9
1998	3403,2	417,3	122,6	245,7	72,2	326,5	95,9	290,8
1999	4530,4	402,8	88,9	269,8	59,6	362,2	79,9	228,4
2000	5843,6	401,2	68,7	295,9	50,6	409,4	70,1	189,4
2001	7427,4	400,8	54,0	232,4	31,3	458,5	61,7	147,0

2. Asia 2

Years	Lines	BSS revenue		MSC revenue		International revenue		Total
of study	operated	million US$	US$/line	million US$	US$/line	million US$	US$/line	US$/line
1992	0,0	0	0,0	0	0,0	0	0,0	0,0
1993	0,0	0	0,0	0	0,0	0	0,0	0,0
1994	84,1	67,5	802,6	33,6	399,5	54,4	646,8	1849,0
1995	667,5	356,6	534,2	182,9	274,0	290,5	435,2	1243,4
1996	4132,3	561	135,8	484,9	117,3	563,2	136,3	389,4
1997	12837,4	1457,4	113,5	1165,6	90,8	874,3	68,1	272,4
1998	22834,3	2198,6	96,3	1455,4	63,7	1218	53,3	213,4
1999	37429,1	3393,6	90,7	2179,5	58,2	1857,7	49,6	198,5
2000	60702,8	3802,6	62,6	2773,3	45,7	2192	36,1	144,4
2001	93391,4	4356,9	46,7	2965,5	31,8	2847,6	30,5	108,9

3. Eastern Europe

Years	Subscribers	BSS revenue		MSC revenue		Contract revenue		Total
of study	000	million US$	US$/line	million US$	US$/line	million US$	US$/line	US$/line
1994	0,0	0,0	na	0,0	na	0,0	na	na
1995	0,1	0,2	2000,0	0,1	1000,0	0,2	2000,0	5000,0
1996	81,0	80,3	991,4	37,7	465,4	63,5	784,0	2240,7
1997	248,2	117,9	475,0	57,3	230,9	58,4	235,3	941,2
1998	825,0	293,0	355,2	153,0	185,5	148,6	180,1	720,7
1999	2128,6	503,4	236,5	296,7	139,4	342,9	161,1	537,0
2000	4280,3	654,2	152,8	410,3	95,9	536,3	125,3	374,0
2001	7519,4	771,2	102,6	539,0	71,7	803,0	106,8	281,0
2002	12158,8	880,7	72,4	689,3	56,7	1184,4	97,4	226,5
2003	18269,8	969,4	53,1	785,5	43,0	1556,2	85,2	181,2

GSM MOBILE NETWORK: TOTAL AND UNIT REVENUE 2

4. Africa

Years of study	Subscribers 000	BSS revenue		MSC revenue		Contract revenue		Total
		million US$	US$/line	million US$	US$/line	million US$	US$/line	US$/line
1992	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1993	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1994	217,3	86,9	399,9	62,4	287,2	80,4	370,0	1057,1
1995	527,2	146,5	277,9	84,1	159,5	76,8	145,7	583,1
1996	908,0	301,3	331,8	128,4	141,4	143,2	157,7	630,9
1997	1654,8	404,1	244,2	215,4	130,2	265,5	160,4	534,8
1998	2740,0	463	169,0	269,2	98,2	368,8	134,6	401,8
1999	3942,5	373,8	94,8	247,2	62,7	380,6	96,5	254,1
2000	5266,1	237	45,0	197,4	37,5	327,7	62,2	144,7
2001	6811,7	166,5	24,4	120,6	17,7	254,6	37,4	79,5

5. Latin America

Years of study	Subscribers 000	BSS revenue		MSC revenue		Contract revenue		Total
		million US$	US$/line	million US$	US$/line	million US$	US$/line	US$/line
1992	0,0	0,0	0,0	0	0,0	0	0,0	0,0
1993	0,0	0,0	0,0	0	0,0	0	0,0	0,0
1994	0,0	0,0	0,0	0	0,0	0	0,0	0,0
1995	0,0	0,0	0,0	0	0,0	0	0,0	0,0
1996	0,0	0,0	0,0	0	0,0	0	0,0	0,0
1997	115,9	79,3	684,2	38,9	335,6	50,6	436,6	1456,4
1998	336,4	129,3	384,4	66,4	197,4	98,6	293,1	874,9
1999	659,2	157,4	238,8	86,4	131,1	149,4	226,6	596,5
2000	1028,2	166,2	161,6	95,6	93,0	197,5	192,1	446,7
2001	1368,0	178,0	130,1	81,9	59,9	230,5	168,5	358,5

6. Middle East

Years of study	Subscribers 000	BSS revenue		MSC revenue		Contract revenue		Total
		million US$	US$/line	million US$	US$/line	million US$	US$/line	US$/line
1992	0,0	0,0	na	0,0	na	0,0	na	na
1993	0,0	0,0	na	0,0	na	0,0	na	na
1994	24,2	20,1	830,6	10,5	433,9	14,4	595,0	1859,5
1995	248,9	157,1	631,2	81,9	329,0	102,4	411,4	1371,6
1996	759,7	297,0	390,9	152,3	200,5	226,3	297,9	889,3
1997	1200,3	450,8	375,6	227,7	189,7	319,3	266,0	831,3
1998	2043,3	500,8	245,1	299,1	146,4	449,9	220,2	611,7
1999	3326,0	603,8	181,5	401,0	120,6	563,2	169,3	471,4
2000	4884,2	570,6	116,8	429,5	87,9	612,9	125,5	330,2
2001	6563,1	527,5	80,4	335,7	51,1	625,1	95,2	226,8

FIXED NETWORK: AVERAGE RETURN

1. Asia Region 25,00%

Years of study	Lines 000	Investment US$/line	Expenses US$/line	Revenue US$/line	Return %
1994	77258	1682,0	420,5	454,4	2,02%
1995	96317	1621,0	405,3	438,1	2,03%
1996	118588	1431,0	357,8	401,5	3,06%
1997	141279	1322,0	330,5	348,6	1,37%
1998	165214	1300,0	325,0	292,0	-2,54%
1999	191208	1305,0	326,3	302,0	-1,86%
2000	219901	1258,0	314,5	316,1	0,13%
2001	249991	1266,0	316,5	334,7	1,44%
2002	281358	1184,0	296,0	359,2	5,34%
2003	312955	1220,0	305,0	384,4	6,51%

2. Latin America 25,00%

Years of study	Lines 000	Investment US$/line	Expenses US$/line	Revenue US$/line	Return %
1994	37041	1380,0	345,0	529,1	13,34%
1995	40498	1392,0	348,0	481,9	9,62%
1996	44450	1285,0	321,3	510,0	14,69%
1997	49740	1226,0	306,5	519,3	17,36%
1998	55414	1225,0	306,3	504,5	16,18%
1999	62457	1120,0	280,0	491,5	18,88%
2000	72823	948,0	237,0	484,4	26,10%
2001	84860	936,0	234,0	486,5	26,98%
2002	95592	983,0	245,8	509,0	26,78%
2003	104631	1028,0	257,0	519,8	25,56%

3. Eastern Europe Region 25,00%

Years of study	Lines 000	Investment US$/line	Expenses US$/line	Revenue US$/line	Return %
1994	45016	1086,0	271,5	232,8	-3,56%
1995	48142	1023,0	255,8	299,1	4,24%
1996	51069	1029,0	257,3	328,0	6,88%
1997	54639	927,0	231,8	356,9	13,50%
1998	58580	1021,0	255,3	385,5	12,76%
1999	62400	985,0	246,3	406,3	16,25%
2000	66185	965,0	241,3	440,3	20,63%
2001	69643	953,0	238,3	485,4	25,93%
2002	72996	936,0	234,0	537,2	32,39%
2003	76225	905,0	226,3	598,4	41,12%

4. Africa & Middle East region 30,00%

Years of study	Lines 000	Investment US$/line	Expenses US$/line	Revenue US$/line	Return %
1994	23858	942,0	282,6	422,0	14,80%
1995	25810	848,0	254,4	406,0	17,88%
1996	28052	883,0	264,9	381,4	13,19%
1997	30458	707,0	212,1	381,9	24,02%
1998	32986	693,0	207,9	376,2	24,29%
1999	36033	734,0	220,2	372,2	20,71%
2000	39490	715,0	214,5	369,4	21,66%
2001	43084	708,0	212,4	368,4	22,03%
2002	46536	685,0	205,5	367,9	23,71%
2003	49505	769,0	230,7	376,3	18,93%

MOBILE NETWORK 1: AVERAGE RETURN

1. Asia 1 25,00%

Years of study	Lines 000	Investment US$/line	Expenses US$/line	Revenue US$/line	Return %
1992	0,0	0,0	0,0	0,0	0,00%
1993	30,4	3690,2	922,6	3694,1	75,11%
1994	218,0	1827,7	456,9	1312,8	46,83%
1995	680,4	1498,0	374,5	912,6	35,92%
1996	1544,0	1201,7	300,4	541,6	20,07%
1997	2485,6	1120,4	280,1	373,9	8,37%
1998	3403,2	1109,0	277,3	290,8	1,22%
1999	4530,4	1061,5	265,4	228,4	-3,48%
2000	5843,6	1012,3	253,1	189,4	-6,29%
2001	7427,4	943,4	235,9	147,0	-9,42%

2. Asia 2 25,00%

Years of study	Lines 000	Investment US$/line	Expenses US$/line	Revenue US$/line	Return %
1992	0	0,0	0,0	0,0	0,00%
1993	0	0,0	0,0	0,0	0,00%
1994	84,1	1849,2	462,3	1849,0	74,99%
1995	667,5	1476,6	369,2	1243,4	59,21%
1996	4132,3	629,3	157,3	389,4	36,88%
1997	12837,4	474,5	118,6	272,4	32,41%
1998	22834,3	480,1	120,0	213,4	19,45%
1999	37429,1	491,5	122,9	198,5	15,39%
2000	60702,8	447,5	111,9	144,4	7,27%
2001	93391,4	399,7	99,9	108,9	2,25%

3. Eastern Europe Region 25,00%

Years of study	Lines 000	Investment US$/line	Expenses US$/line	Revenue US$/line	Return %
1994	0,0	0,0	0,0	0,0	0,00%
1995	0,1	21,8	5,5	5000,0	22910,78%
1996	81,0	2247,6	561,9	2240,0	74,66%
1997	24,2	1675,0	418,8	941,2	31,19%
1998	825,0	1224,6	306,2	720,7	33,85%
1999	2128,6	1011,6	252,9	537,0	28,08%
2000	4280,3	877,1	219,3	374,0	17,64%
2001	7519,4	780,3	195,1	281,0	11,01%
2002	12158,8	709,1	177,3	226,5	6,94%
2003	18269,8	653,5	163,4	181,2	2,73%

MOBILE NETWORK 2: AVERAGE RETURN

1. Africa 25,00%

0	Lines	Investment	Expenses	Revenue	Return
0	000	US$/line	US$/line	US$/line	%
1992	0,0	0,0	0,0	0,0	0,00%
1993	0,0	0,0	0,0	0,0	0,00%
1994	217,3	1056,9	264,2	1057,1	75,02%
1995	527,2	1018,5	254,6	583,1	32,25%
1996	908,0	1222,5	305,6	630,9	26,61%
1997	1654,8	1205,6	301,4	534,8	19,36%
1998	2740,0	1130,0	282,5	401,8	10,56%
1999	3942,5	1039,4	259,9	254,1	-0,55%
2000	5266,1	922,8	230,7	144,7	-9,32%
2001	6811,7	793,0	198,3	79,5	-14,97%

2. Latin America 25,00%

Years	Lines	Investment	Expenses	Revenue	Return
of study	000	US$/line	US$/line	US$/line	%
1992	0,0	0,0	0,0	0,0	0,00%
1993	0,0	0,0	0,0	0,0	0,00%
1994	0,0	0,0	0,0	0,0	0,00%
1995	0,0	0,0	0,0	0,0	0,00%
1996	0,0	0,0	0,0	0,0	0,00%
1997	115,9	1456,4	364,1	1456,4	75,00%
1998	336,4	1376,3	344,1	874,9	38,57%
1999	659,2	1299,0	324,8	596,5	20,92%
2000	1028,2	1279,5	319,9	446,7	9,91%
2001	1368,0	1320,2	330,1	358,5	2,15%

4. Middle East region 25,00%

Years	Lines	Investment	Expenses	Revenue	Return
of study	000	US$/line	US$/line	US$/line	%
1994	0	0,0	0,0	0,0	0,00%
1995	0	0,0	0,0	0,0	0,00%
1996	24,2	1859,3	464,8	1859,5	75,01%
1997	248,9	1550,9	387,7	1371,6	63,44%
1998	759,7	1397,9	349,5	889,3	38,62%
1999	1200,3	1716,1	429,0	831,3	23,44%
2000	2045,3	1618,2	404,6	611,7	12,80%
2001	3326	1467,1	366,8	471,4	7,13%
2002	4884,2	1329,3	332,3	330,2	-0,16%
2003	6563,1	1216,0	304,0	226,8	-6,35%