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Telecommunications needs and satisfaction of demand

Part 2: Implementation of radio systems in developing countries

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TELECOMMUNICATIONS NEEDS AND SATISFACTION OF DEMAND

Part 2: Implementation of radio systems in developing countries

Synopsis. The paper illustrates, by World Regions (Asia & Pacific, Latin America, Eastern Europe, Africa & Middle East) the development of telecommunication services. The general approach concerns some current application of radio systems to support and complement the capacity and the performances of traditional fixed network. An investigation per Region is carried out by focusing the expansion of mobile service upon which Service Providers, Traditional Operators and Industry concentrate, at present, their strong interest. Possible trends are, eventually, shown for telecommunications services.

CONTENTS

1. Experiencing development in Telecommunications

The continuous technological progress in designing and manufacturing telecommunication equipment was, so far, characterised by the digitisation of exchanges, the introduction of new transmission techniques and the wide use of computers. As a results of such advances the telecommunication networks got greater functionality and capacity so that new services could become available such as data communications, mobile cellular communications, and image transmission. The move into a new technological phase made, as well, possible the reduction of costs for infrastructures (terrestrial and satellite).
Meanwhile, under the pressure of increasing market demand, the Operators tried to reduce the waiting list by implementing substitutive services through a more intensive use of radio communications resources.

1.1 - *The expansion of mobile communications*

There are two main directions towards which mobile systems are at present expanding.
In countries where a sound socio-economic environment is taking place, consumers are demanding for cellular service as well as for other mobile facilities (radio paging; mobile data; public access cordless Telephony system). In those countries where potential customers suffer long waiting time (1 to 10 years !!) then mobile system may provide access to national network substituting the fixed-line connections.

1.2 - *The progress of Wireless Local Loop*

WLL did not expand as it was expected. Regulators take long time to give concessions. Operators are hesitant to make their technical choice and Suppliers who have no willing of investing to improve technology or to reduce selling prices until the market is such as to provide adequate return.
The only reasonable justification for this market strategy, especially when telephone may still provide social benefit, is to imagine that Regulators and Operators are concerned to avoid possible deterioration of existing quality and do not want to force into the system more lines than the capacity and the functionality of their network can actually serve. Within the same concept it is, as well, reasonable to think that Suppliers would be much happier to provide equipment and systems to a growing market rather than to deal with limited market niches.

1.3 - *The evolution of rural communications*

Privatisation and competition risk to make the problem of rural telecommunications furtherly neglected or delayed as the Regulatory Entities might find it difficult to force new entrants to provide rural telecommunications. In all those cases where a social obligation can be established, a liberalised telecommunication environment can support rural telecommunications (Universal Service Obligation).
Still remain, for this particular sector, the main critical issues that make the feasibility of the service difficult to achieve. In particular, the low population densities, the limited income/capita and the distance from main commercial centres keep the rural service a very expensive and not attractive project.

1.4 - *The Personal Handy-phone System (PHS)*

PHS is a two-way system that offers a range of low-cost advanced services (fax, data and multimedia). Programmed in 1991, it started commercial service by middle 1995; it is expected to reach a market share of more than 7 million users in 2000. The success of PHS is given by its performances: the system hand-set weights 75g and offer five hours of talk time and 400 hours of standby using standard consumer electronic batteries. In addition, the system base stations are cheap, enabling additional coverage to be provided in areas that are not covered by the cellular. The system operates close to the 1.9 GHz frequency and may provide low-cost service in city centres, business areas, train stations, home and office.

2. Regional experiences: Asia 1

The Region named "Asia 1" includes Hong Kong, Singapore, South Korea and Taiwan. The cellular market in the Area shows the highest penetration rate in the World. The mobile systems in use are, fundamentally, three: the GSM, the D-AMPS and the CDMA. For GSM systems, Nortel dominates the market with the greatest share either for transceivers and for switching capacity supplied:

Manufacturer involved	Transceivers supplied	Share in % manufacturers	MSC capacity Supplied	Share in % manufacturers
Nortel	3100	34,7%	18400	34,7%
Ericsson	2900	32,3%	17200	32,3%
Nokia	1600	18,6%	9900	18,6%
Motorola	1300	14,4%	0	0,0%
Siemens	0	0,0%	7600	14,4%
Total	**8900**	**100,0%**	**53100**	**100,0%**

Hong Kong. It is the area where the greatest number of licences have been released: 22 networks to support the needs of 6 million people. Such a liberalisation at provider level is applied as well to the technological sector: providers may choose among D-AMPS, GSM and CDMA systems. Hong Kong was the first in the Area to implement CDMA network in order to overcome the capacity limits of its analogue cellular system.

Singapore. After years of monopolistic regulation, the second Operator in Singapore, MobileOne, was licensed only in 1997. Both GSM and DCS-1800 are offered to national market as a dual band service.

South Korea. In South Korea a second Operator, Shinsegi, compete with KMT in providing digital cellular service. Korean manufacturers were given significant market opportunity by the Government that supported the CDMA system: at present more than one million subscribers are connected to CDMA network (700000 subscribers for KMT and 300000 for Shinsegi).

Taiwan. After an early decision towards the AMPS technology, the monopoly Operator chose the GSM system. When liberalisation was introduced eight new Operators could enter the national market and separated into six regional and two national licenses. The national licences are based on DCS-1800, three of the regional licences are based on GSM nd the other three on DCS-1800.

3. Regional experiences: Asia 2

The Region named "Asia 2" covers the rest of Asia from Afghanistan to Vietnam excluding Japan. The cellular market in the Area shows the highest penetration rate in the World. The mobile systems in use are, fundamentally, three: the GSM and the D-AMPS. For GSM systems, Motorola dominates the market with the greatest share either for Base Stations while Siemens dominates the switching market:

Manufacturers involved	Transceivers supplied	Share in % manufacturers	MSC capacity supplied	Share in % manufacturers
Motorola	9300	25,4%	0	0,0%
Ericsson	8800	24,0%	63600	27,4%
Nokia	6400	17,4%	50700	21,8%
Nortel	6300	17,3%	8500	3,7%
Siemens	2700	7,4%	79500	34,3%
Alcatel	2500	6,9%	26300	11,3%
Lucent technology	600	1,6%	3600	1,6%
Total	36700	100,0%	232100	100,0%

The Region has a population of almost 6 billion people (more than 50% of the world's inhabitants) and contains developing countries within a wide difference in culture and economy. PSTN (Public Switched Telecommunication Network) penetration is generally low so, the existence of an unsatisfied potential demand makes this market interesting to cellular suppliers especially in China and India.
Regulatory arrangements differ accordingly with political and economic development within the region: in some countries competition has been introduced while in others monopoly still prevail. Release of licenses is still a limited process: only in some countries, together with the existing licensed operators there are opportunities for other competitors.
Mobile service in the Region started with the analogue cellular standards; because of China's choice of TACS technology, analogue systems is expected to be the largest market in the area for some years ahead. China and India moved towards GSM as digital cellular standard. Nevertheless the "flexibility" of Regulators will certainly let other standards (A-AMPS; CDMA) enter the market.

4. Whole Asia. Balance between mobile and fixed services

A possible indicator to measure the "rate of substitution" between fixed and mobile service should be the percentage of mobile cellular subscribers do have no wireline telephone: as this statistic is unavailable, the indicator was replaced by an alternative measure that is the ratio between the number of mobile subscribers and the number total of subscribers.

Years of analysis	Telephone subscribers Fixed network	Mobile subscribers Radio network	Ratio mobile/fixed Main indicator
1994	110261	302,1	0,27%
1995	138720	1347,9	0,97%
1996	174605	5667,3	3,25%
1997	199880	15323,0	7,67%
1998	226104	26237,5	11,60%
1999	255970	41959,5	16,39%
2000	289032	66546,4	23,02%
2001	324204	100818,8	31,10%

5. Regional experiences: Latin America

As the fixed networks operated in the Region (380 millions inhabitants) are underdeveloped, Latin America represents an interesting potential market for mobile service: in particular, most of the market (60%) is concentrated in three countries: Argentina, Brazil and Colombia.
The usage characteristics of cellular in Latin America - low mobility in dense urban areas, high usage rates and popularity of lightweight phones – provide favourable conditions for PCS type service.
With North America so close, AMPS has been the analogue cellular technology used in the Region. In most countries of the Region the market liberalisation was regulated, for some time, by issuing regional licenses; competition could be introduced, so far, only in some large countries.
The manufacturers market shares for D-AMPS cellular infrastructures are as follows:

Manufacturer Involved	D-AMPS TRX supplied	Share in % manufacturers	D-AMPS capacity supplied	Share in % Manufacturers
Ericsson	15900	65,2%	28900	64,9%
Nortel	8500	34,8%	15600	35,1%
Total	24400	100,0%	44500	100,0%

Argentina. Two AMPS Operators (Movicom and Movistar) got most of subscribers around Buenos Aires: a third Operator (Compania de Telefonos del Interior) is offering, since 1994, mobile service in the

north and in the South of the country. According to such "de facto" separation the Government will issue regional PCS licenses for: Buenos Aires, North Region and South Region.

Brazil. In Brazil, Telebras and its subsidiaries have operated telecommunications service, under a monopolistic regulation, in the 27 States of the country. When, in 1996, the Telecommunication Act was approved and entered into force the issue of licenses started and in the same time the regional subsidiaries of Telebras were grouped in six7seven Entities. The potential market that the new competitors will share is significant as the cellular waiting list included, already in 1996, 1-2 million applicants.

Colombia. The country is separated into three regions: North, East and West where Celumovil, Celcaribe, Comcel, Occel and Cocelco are operating.

5.1 – *Latin America. Balance between mobile and fixed services*

A possible indicator to measure the "rate of substitution" between fixed and mobile service should be the percentage of mobile cellular subscribers do have no wireline telephone: as this statistic is unavailable, the indicator was replaced by an alternative measure that is the ratio between the number of mobile subscribers and the number total of subscribers.

Years of analysis	Telephone subscribers Fixed network	Mobile subscribers Radio network	Ratio mobile/fixed Main indicator
1994	40990	0,0	0,00%
1995	45714	0,0	0,00%
1996	50854	0,0	0,00%
1997	56212	115,9	0,21%
1998	63141	336,4	0,53%
1999	71450	659,2	0,92%
2000	83200	1028,2	1,24%
2001	96833	1368,0	1,41%

6. Regional experience: Eastern Europe

The Region is potentially one of the largest growth market in Telecommunications. After the communism, the region has faced both political and social issues as well as fundamental economic problems to solve. There are significant differences among the level of developments in the Region with the economic power of consumers decreasing from west to east: but it seems that the principle that there is a strong correlation between the economic activity levels of countries and their availability or usage of telecommunications networks has been recognised by most authorities. As to rely on development in the fixed networks would have taken time which many Governments did not have, most of them sought went in for an alternative solution that would provide some capacity in very short time. For operators seeking to cover a broad area in a short period and at a reasonable price, cellular communications offers a ready-made solution.

Most networks are operated by joint ventures formed between the local PTO and Western partners owing to a combination of factors: Western manufacturers are the only sources of cellular technology, indigenous PTO lack funds and most countries suffer from currency exchange problems. Typically, the local partner would retain a majority stake in a network operator which had an initial monopoly and a fixed-term license. The western partner generally provided both the funding and the expertise in cellular operation.

Following the first issue of licenses, many national regulators re-examined the situation in their countries. Most clearly they believe that further activity in this sector would be beneficial to the overall economy, with competition leading to more attractive offerings and tariffs, and higher uptake by both indigenous and international organisations and individuals. In addition, the launching of GSM Operators also reflects a political desire to join the EU, in which such networks are strongly encouraged.

In supplying both GSM base stations and switches to many of the current networks, Nokia has made a major commitment to his market and established a string market share.

Manufacturer involved	Transceivers supplied	Share in % manufacturers	MSC capacity supplied	Share in % manufacturers
Nokia	3000	45,8%	19300	45,8%
Ericsson	2500	38,2%	16200	38,2%
Siemens	600	9,0%	6500	15,5%
Motorola	400	6,5%	0	0%
Alcatel	35	0,5%	200	0,5%
Total	**6535**	**100,0%**	**42300**	**100,0%**

6.1 *Eastern Europe. Balance between mobile and fixed services*

A possible indicator to measure the "rate of substitution" between fixed and mobile service should be the percentage of mobile cellular subscribers do have no wireline telephone: as this statistic is unavailable, the indicator was replaced by an alternative measure that is the ratio between the number of mobile subscribers and the number total of subscribers.

Years of analysis	Telephone subscribers Fixed network	Mobile subscribers Radio network	Ratio mobile/fixed Main indicator
1994	50418	81,0	0,16%
1995	53166	248,2	0,47%
1996	56980	825,0	1,45%
1997	61319	2128,6	3,47%
1998	67505	4280,3	6,34%
1999	72536	7519,4	10,37%
2000	77225	12158,8	15,74%
2001	81266	18269,8	22,48%

7. Regional experience: Africa

From a telecommunications perspective Africa represents one of the least developed region in the world: few African countries look set to support the kind economic growth seen and expected in other "developing" regions. Generally speaking Africa has been beset by political, economic and social problems. While very low PSTN penetration across the region might be viewed as an opportunity for cellular solutions to increase capacity, even this level of investment may not be generally available in the short term.

South Africa is by far the dominant cellular market in this region and will remain so. The launch of GSM in this country with competition between operators and service providers led to an immediate explosion in the market.

There are also brighter signs elsewhere. Political stability, while varying across the region is improving in a number of countries. At the same time, many Governments are seeking actively investment in cellular and other communications services. As with other underdeveloped regions, Africa may, in the medium term, become a major area of opportunity for wireless solutions.

Individual countries in Afrca have adopted a wide range of analogue cellular standards among which AMPS and TACS will remain dominant in numerical terms.

South Africa's choice of gSM has ensured its place as the main digital standard. The country 's lead has now been followed by a large number of other African states, with many launches planned over the next few years.

Generally the PTO in a country has launched the first service. although there are a handful of cases in which international investors such as Millicom and Vodafone have taken significant shares in such monopoly operations. This trend is increasing as governments come to appreciate the economic and social benefits of reliable communications and exchange a rigid doctrine of state control over nothing for a share in something. From investors point of view potential investors should be prepared for a long haul. One possible advantage for a cellular network operator in this region is that if the situation becomes unfavourable, it is easier to pick up a cellular network and take it elsewhere than to dig up a national cable network.
While the need is clearly there, it remains difficult to make aggressive forecasts for cellular growth in a region with considerable economic and political challenges.
The manufacturers market share for GSM cellular infrastructures in Africa is as follows:

Manufacturer involved	GSM TRX Supplied	Share in % Manufacturers	MSC capacity supplied	Share in % Manufacturers
Ericsson	2300	37,5%	5000	37,3%
Alcatel	2000	32,6%	400	3,1%
Motorola	1800	29,1%	0	0,0%
Nokia	100	0,8%	0	0,0%
Siemens	0	0,0%	8000	59,5%
Total	**6300**	**100,0%**	**13500**	**100,0%**
2000	**10,9%**	**4,96%**	**0,30%**	**21,47%**

8. Regional experience: Middle East

While Middle East region includes a number of wealthy countries which were early adopters of cellular. growth in this region has generally been slow. 1996 shows a significant growth in a number of markets particularly in Israel where the competition between the two Operators has manifested itself in a fascinating battle and a subsequent huge jump in subscribers.
Operators in Middle East have generally chosen European standards and suppliers for their analogue networks; the only exception was Israel where string ties with US resulted in the adoption of AMPS Israel will be also the exception in its choice of digital standards: the second Israeli operator had based its network on D-AMPS technology and CDMA as well. Elsewhere GSM has swept the region.
Foreign investment has tended to prove less important than the control in this oil-rich region
With the benefits of digital technology, a degree of competition in some countries and the opening of several markets will help to accelerate growth in this region.
Motorola and Siemens dominate the market as a result of their strong position in Israel where they jointly own one of the Operators. As GSM grows to dominate the region during the next few years, there will be much greater opportunities for new entrants.

Manufacturer involved	GSM TRX Supplied	Share in % Manufacturers	MSC capacity supplied	Share in % manufacturers
Motorola	2600	39,2%	0	0,0%
Ericsson	1700	25,9%	11000	26,5%
Lucent Technology	1500	23,2%	9900	23,8%
Alcatel	300	4,2%	1800	4,3%
Nokia	200	3,2%	1400	3,3%
Nortel	200	2,3%	0	0,0%
Siemens	100	1,9%	0	0,0%
Total	**6500**	**100,0%**	**41500**	**100,0%**

Israel. The two operators in the country have already been very innovative in reducing and re-packaging tariffs to target different sector of the market.
Lebanon. A massive growth of the demand is recognised in Lebanon largely because of the lowest tariffs in the world. Among others this has led to an average usage of 800 1000 minutes per month, five times greater than in Western Europe.
cellular network.: only Israel chose the TDMA standard as GSM frequencies were unavailable.

9. Africa/Middle East. Balance between mobile and fixed services

A possible indicator to measure the "rate of substitution" between fixed and mobile service should be the percentage of mobile cellular subscribers do have no wireline telephone: as this statistic is unavailable, the indicator was replaced by an alternative measure that is the ratio between the number of mobile subscribers and the number total of subscribers.

Years of Analysis	Telephone subscribers Fixed network	Mobile subscribers Radio network	Ratio mobile/fixed Main indicator
1994	24501	241,5	0,99%
1995	25900	776,1	3,00%
1996	28474	1667,7	5,86%
1997	31135	2855,1	9,17%
1998	33542	4785,3	14,27%
1999	36688	7268,5	19,81%
2000	40153	10150,3	25,28%
2001	43689	13374,8	30,61%

10. Conclusions

As a general conclusion of the overview made in previous paragraphs, a number of considerations can be developed to give better focus of approaches and choices open to the strategic choices of Operators particularly for those in developing countries.

10.1 - *Regulatory issue*

In the countries where competition is considered one of the way to get economic resources to develop Telecommunication service, a clear regulatory mechanism should be settled down. It has to give rules for the market entry, for foreign investments, for concession of licenses, for interconnection and for Universal Service Provision. Such an Authority should be independent from the Communication Ministry.
A lack of regulatory control and inexperience with foreign investors may allow a joint-venture or a business co-operation for a limited, profitable project, with no obligation to develop the rest of the network. As a result the Telecommunications service cannot grow in a balanced and sound way and has limited access to funds for development of less profitable areas.

10.2 - *The wireless technology.*

According to the survey carried out in this paper it seems that no leading technology can be identified in the Telecommunications markets and that a clear trend has still to emerge. Operators whose primary objective is the expansion of basic telephony services has tended to adopt analogue-based cellular technologies and many are now moving towards implementation of digital-based technologies.
In Europe, the DECT technology is seriously considered as the solution of the last mile access element. In Japan, as well, commercial PHS networks can encourage competition in the local loop.

Future expansion of WLL. The use of cordless solutions in the local loop is currently not widespread. Although this should be seen in the light of the current size of the market, which is relatively small, the

WLL solution is, anyway, expected to have a significant expansion in the future. The estimates (over the period 1995-2000) range from an optimistic growth of 10 million lines per year to a pessimistic forecast of 1,5 million lines per year .

The choice of standards for WLL will continue to be driven by the **availability of frequencies** until the industry promotes regional standards and policy recommendations for WLL, since a concerted actions by might have a significant impact.

10.3 - *Broadband communications*

A telecommunications network based on broadband capacity may turn the telephone network from a medium for voice and text communications into a multimedia network able to carry video, image services, high speed data communications and other computer-to-computer traffic. This requires the implementation of re-cabling with fibre not only at the trunk level but also at the subscribers level (local loop). The objective might be reached by using the data compressing technology to produce equivalent high level of performances. Or by software-defined switching standards (Asynchronous Transfer Mode) to enable higher functionality in existing networks: in this case it is required the installation of intelligent switching and terminal equipment rather than the replacement of the cables.
Such planning seems far distant from the experience of developing countries even if there is some belief that low income countries may take profit out of the development of broadband communications.
The installation of fibre in new network is already more economic than copper, and the developing countries might have the chance to jump one stage in network evolution moving from narrow to large band network. But, on one side, all this costs money and, on the other side, Operators should provide new expensive services in a limited market which might not make the business profitable.

10.3 - *Internet*

Internet is actually a "network of networks" which provides connectivity between different computer networks. As the messages are exchanged between computers, not only the characteristics of the original message are preserved but also the text can be amended and re-edited. The first experience of computer to computer communication was carried up between 1980 and 1990: the process of electronic messaging would have required the establishment of common standards. But, despite the activity of the "Open Standards Interconnection" (OSI), only some standards have been successful and accepted by the market (X.25 packet switched data communications standard; X.400 series electronic message handling standards; Integrated Services Digital Network). By the end of the period Internet came into the market and became "de facto" the common standard as it could provide basic interconnectivity between a variety of different networks operating under different protocols.
The development of new service such as text and data communications enables Public Telecommunications Operators to diversify their offer to the market in order to avoid to be dependent on telephony as the sole source of revenue. The implementation of new services (facsimile, electronic mail and data communications) should anyway be supported by a significant market preference otherwise ther is the risk of providing a luxury service. This is said thinking mainly to developing countries where Operators might be hesitant to develop a range of new telecommunication services before the basic service has sufficiently expanded. In economic terms, Internet may offer significant promise to the developing countries because Internet has not volume-based tariffs, and because it is using flat rate chargingtariffing.

10.4 - *Satellite systems*

Personal Communications Mobile Satellite Services (PC-MSS) is intended to be complementary to the existing terrestrial networks and may fill in existing gaps in service provision, especially in remote areas without an existing service or in areas where conventional cellular radio is unprofitable. There are economic, regulatory and political constraints to PC-MSS in addition to the obstacle represented by the own cost of the system. Moreover existing Operators, by introducing facilities such as calling cards, credit

telephone cards and country direct services, already provided a partial competition allowing their customers to use telephone in foreign countries as they were using their home telephone.
The economic constraints to PC-MSS are the need to interconnect with existing mobile and fixed-networks and to provide services at a competitive cost.. Traditionally the International Satellite Organism (ISO) has provided only the space segment between the gateways of PTO : national signatories provided end-user connection. So that, the development of a global mobile satellite telephone service, will involves the political issue of persuading sovereign States to enter the national market for the offer of service and to allow the use of the spectrum. Consequently ISO Members might move into a situation by which they are competing with each other, and with their own national signatories.
A number of developing countries might think to exploit the potential of PC-MSS, especially for providing those services which are uneconomic (service provision: remote rural areas) or difficult to plan (safety of life, disaster relief). PC-MSS might be complementary and possibly will not compete with existing terrestrial services, nonetheless, the existence of the service may provide the advantage of making revenues in foreign currencies which can be used to finance network development.