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Modern Communication Potential and Needs in Developing Countries

Part 2:

A regional survey about the success of wireless systems

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MODERN COMMUNICATION POTENTIAL AND NEEDS IN DEVELOPING COUNTRIES

Part 2: A regional survey about the success of wireless systems

Synopsis. The paper illustrates the status of development of radio communications in four Regions of the World (Asia&Pacific, Latin America, Eastern Europe, Africa&MIddle East) using statistics of selecte countries pe Region. Reference is made to the perentration of services and to their possible development and emphasis is given to the trend of cellular service to measure its level of competition with the fixed network. Three case studies are shown which help analyze some details about the key factor by which Operators orient their technical and commecial choices.

Contents

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 taing 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.
A possible indicator to measure such "rate of substitution" might be the percentage of mobile cellular subscribers without a wireline telephone; as this statistic is unavailable, a useful alternative indicator is the ratio between the number of mobile cellular subscribers as a percentage of total wireline subscribers. Relevant figures are given in the following by Region. The ratios expected by the year 2000 are generally higher than 20%.

The progress of Wireless Local Loop

It should not be surprising that, during 1996, WLL did not expand as it was expected since it seems that the whole process turned into an odd loop. On one side there are Regulators who slow down the concessions and Operators who hesitate to make their technical choice. On the other side there are Suppliers who have no willing of investing to improve technology or to reduce selling prices of equipment until the market provides adequate return.
It is, maybe, reasonable to imagine that Regulatros and Operators are concerned to avoid possible deterioration of existing quality and do not want to force into the system more lines than the network can actually serve. 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.

In practical terms, the critical reasons which did not favour the environment necessary and sufficient for the system to develop according to the programmes and the preliminary projects can be summarized as follows:

- inadequate allocation of spectrum and delay in licensing operators;
- WLL system prices did not drop down as quickly as expected;
- WLL did not always help serving sparsely populated rural areas;
- the lack of industry standards did not drive correctly the choices of Operators;
- limited data/fax transmission rate reduced the competitive advantage of WLL;
- voice quality is not always equivalent to copper/fibre.

The evolution of rural communications

Privatization 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 entrant to provide rural telecommunications. In all those cases where a social obligation can be established, a liberalized telecommunication environment can support rural telecommunications.
Still remain, for this particular sector, the main critical issues that make he feasibility of the service provided difficult to achieve. In particular, the low population densities, the limited income/capita and the distance from main commercial centres keep the rural service an expensive project which produce return in a longer run than operators are willig to make.

A new system: the Personal Handyphone 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 backers of PHS International are, however, keen to stress that the uptake of PHS will not be at the expense of digital cellular service. The success of PHS is given by its performances: the system handset weights 75g and offer five hours of talk time and 00 hours of standby using standard consumer electornic batteries that can be found everywhere. 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 which was allocated to WARC to the planned future public land mobile telephone system. The key concept is to provide a convenient low-cost service in city centres, business areas and train stations; the systema is also suitable for both home and office use. The installation of a household base unit enables the same handset to be used at home at the PSTN tariffs in a rural area it is heavily used.

Asia&Pacific region: past and expected development

The summary of the past and expected development of Telecommunications services within the period 1994-2000 is given in the following table. The statistics refer to a sample of 11 countries in the Region and relates telephone (main lines), cellular and PCS lines operated to the of population of the sample:.
The ratio of cellular subscribers to the main telephone lines is expected to reach, by the year 2000, 22% and correspond to a rough measure of the market share that cellular is supposed to take over time.

(11 countries selected; 2,7 billion population in 1996)

Years	Telephone	cellular	PCS	cellullar/telephone
1994	2,91%	0,20%	0,00%	7,12%
1995	3,58%	0,40%	0,00%	10,27%
1996	4,31%	0,60%	0,01%	12,89%
1997	5,08%	0,80%	0,04%	15,60%
1998	5,81%	1,00%	0,10%	17,28%
1999	6,61%	1,30%	0,18%	19,00%
2000	7,71%	1,78%	0,48%	22,15%

Cellular service

Ericsson is the main supplier of cellular network equipment in the Asia&Pacific Region due to its share in the markets of China, Australia and Japan. Motorola and NEC have, as well, a strong position in the Region; new suppliers are entering the market such as Nokia, Alcatel, Northern Telecom and Siemens.
Most of the growth process is related to the implementation of GSM which is taking in the Region a leading de-facto position. Market opportunities are also available in the sector of fixed wireless equipment which are mainly use in order to reduce the cost of Telecommunications infrastructures.

Rural services

Although urbanization is growing (Hong Kong, Singapore, Taiwan, Korea) over a half of Asian population remains rural. Most of the Asia's heavily populated countries are over 70% rural including Bangladesh, China, India, Myanmar, Sri Lanka, Thailand and VietNam. The economic impact of the agricultural sector is significant: it contributes around 20% of Gross Domestic Product in South East Asia and about 30% in more rural South Asia.
Sufficient resources should be allocated to rural telecommunications to raise the standard of living of the majority of the region's inhabitants. Adequate rural telecommunications would also reduce internal mi-

gration thus alleviating problems associated with growing urbanization and contributing to the development of turism, handicraft and other off-farm employment.

The PHS system

A new consortium, called PHS International, has been established by Japan NTT (27%), Cable & Wireless (27%), Hongkong Telecom, (23%), Itochu Corporation (23%). The objective is the promotion of the Japanese PHS (Personal Handyphone System) standard for digital cordless communications.
The first deployment of PHS is expected to be in Hong Kong, as Hong Kong Telecom has applied for a cordless access service license and has choiced PHS technology as its technical requirement. Experiments are going on in Hong Kong, Malaysia and Indonesia, and interest has been shown by China, Singapore, the Philippines, Vietnam Thailand and India.

Latin America: past and expected development

The summary of the past and expected development of Telecommunications services within the period 1994-2000 is given in the following table. The statistics refer to a sample of 8 countries in the Region and relates telephone (main lines), cellular and PCS lines operated to the of population of the sample:.
The ratio of cellular subscribers to the main telephone lines is expected to reach, by the year 2000, 31% and correspond to a rough measure of the market share that cellular is supposed to take over time.

(8 countries selected; 402 million population in 1996)

Years	Telephone	cellular	PCS	cellular/telephone
1994	9,05%	0,50%	0,00%	5,79%
1995	9,66%	0,90%	0,00%	9,14%
1996	10,32%	1,30%	0,00%	13,04%
1997	11,16%	1,90%	0,06%	16,70%
1998	12,10%	2,40%	0,19%	20,23%
1999	12,96%	3,10%	0,43%	24,12%
2000	13,95%	4,25%	0,62%	30,74%

Cellular service

Leading vendors of cellular equipment in the Region are Ericsson, Motorola, NEC, Northern Telecom.
Ericsson supplies technical infrastructures for the cellular network of TelCel; it also supplies equipment to 10 of 25 cellular regions covered by Telebras as well as to Movistar (Argentina), Movilnet (Venezuela) and Celcaribe.
Motorola has, as major customers, Movicom (Argentina), Telecom Cellular/VTR (Chile), TelCel (Venezuela) and 2 of Telebras 25 cellular areas.
NEC supplies equipment to Telebras cellular companies operating in Sao Paolo, Rio de Janeiro and Parana areas.
Northern Telecom is the equipment supplier for five of nine networks in Mexico. It also supplies equipment to four of five regional operators in Colombia.

Operators, in the Region, appreciate the European GSM standard but, in practice, most Latin America countries are choosing digital AMPS rather than the GSM standard. Brazil and Colombia may prove to be an exceptions to this trend. .GSM's main hope lies in the fact that European telecoms operators, particularly Telefonica, France Telecom and Telecom Italia, control much of the market .

Rural service

The expansion of the telecomunications service in rural areas is neither easy nor necessarily economically feasible but the implementation of the service per individual potential user is not the only and

unique way to provide service in such areas. There are cases when the objective can be attained in a number of different ways. i.e. payphones or teleservice centres.
Teleservice Centres are a modern version of the traditional public call office; there is now a wider range of service offered either because the technology has made available new services and because new demand is showing up (library, farm data recording, livestock programmes, training, education).
In Latin America the average Telecommunications density in rural areas accounts for 10%-20% of density in urban centres; the penetration of Telecommunications service is, in fact, of 2,5%. The plans to expand the Telecommunications service in rural areas and to accelerate the satisfaction of rural needs include the use of radio connection in the local loop (fixed cellular service).

Personal Communications Services.

Personal Communication Service (PCS) is at a stage of project in, at least, Argentina, Chile and Mexico. So far Latin America is using the same frequency allocations as the industry in the US and Canada, to get advantage from economies of scale in equipment manufacture and to favour the prospects for PCS international roaming.

Eastern Europe: past and expected development

The summary of the past and expected development of Telecommunications services within the period 1994-2000 is given in the following table. The statistics refer to a sample of 8 countries in the Region and relates telephone (main lines), cellular and PCS lines operated to the of population of the sample:.
The ratio of cellular subscribers to the main telephone lines is expected to reach, by the year 2000, 6% and correspond to a rough measure of the market share that cellular is supposed to take over time.

(8 countries selected; 300 millions population in 1996)

Years	Telephone	cellular	PCS	cellular/telephone
1994	15,85%	0,10%	0,00%	0,57%
1995	16,96%	0,20%	0,00%	1,09%
1996	18,46%	0,30%	0,00%	1,75%
1997	20,07%	0,50%	0,02%	2,52%
1998	21,79%	0,80%	0,07%	3,46%
1999	23,54%	1,00%	0,15%	4,30%
2000	25,56%	1,53%	0,22%	6,06%

Cellular service

A great recourse to WLL technology is expected in this Region even if some isolated experiences show that the expansion of the system suffered very much during 1996 (less than 50% of objectives reached in terms of new WLL operated.
Main suppliers in the Region are Ericsson and Motorola. The provision of equipment comes through competitive tenders. Preliminary trials are conducted to check the system performance.

Rural service

In this sector as well the use of WLL is foreseen. In general the Operators in the Region are given by their Regulator the obligation to provide universal service; there are as well cases where it becomes mandatory to new licensed operators to dedicate a certain percentage of their investment to develop rural Telecommunications.

Africa/Middle East: past and expected development

The summary of the past and expected development of Telecommunications services within the period 1994-2000 is given in the following table. The statistics refer to a sample of 14 countries in the Region and relates telephone (main lines), cellular and PCS lines operated to the of population of the sample:.
The ratio of cellular subscribers to the main telephone lines is expected to reach 21%, by the year 2000, and correspond to a rough measure of the market share that cellular is supposed to take over time.

(14 countries selected; 408 millions population in 1996)

Years	Telephone	cellular	PCS	cellular/telephone
1994	7,01%	0,40%	0,00%	2,64%
1995	7,48%	0,90%	0,00%	5,55%
1996	8,08%	1,50%	0,00%	8,94%
1997	8,73%	2,10%	0,04%	11,26%
1998	9,43%	2,80%	0,12%	13,83%
1999	10,17%	3,50%	0,21%	16,38%
2000	10,9%	4,96%	0,03%	21,47%

Cellular services

Traditionally, Africa and the Middle East have been hostile to private sector participation however, in the last five years, the introduction of cellular services has opened the the co-operation both to foreign and local sectors, throught thee Regions. Financing difficulties accelerate the move towards liberalization and privatization in order to attract foreign investments.
In late 1995 Zimbabwe broke the state monopoly on cellular service. Uganda is advancing with plans to privatize the PTT and introduce a secon basic operator services in 1996.
Jordan, Namibia, Leshoto, Malawi and Tanzania introduced private cellular operators following the success of South Africa's two private cellular operators.
Israel is has already a second celular operator andl is expected to tender a third cellular license.
Ghana, Tanzania, Ivory Coast are experimenting with licensing multiple operators to stimulate the network development. Most handset markets have been liberalized over the past five years, even in the traditionally protected Gulf markets. In this part of the Region, almost every country licensed a GSM cellular network.; only Israel chose the TDMA standard as GSM frequencies were unavailable.

Rural services

In Africa, rural network development was so far pursued by installing small capacity digital exchanges in rural centres but, as in other Regions, no clear strategy or plans were adopted for a sound growth of the sector. In the short recourse was made to private financing for rural expansion using wireless technology; from economic point of view the wireless systems appears to be a feasible solution, as the high cost of local loop in remote areas (scarsely populated zones) creates problems to the traditional copper solution.
The suppliers come from Europe, North America and Asia. The production of equipment should take account of long distance from users to switch (protection from frequency interference) and of the lack of power supply (solar power option).
In Middle East, in general, the provision of Universal service is an obligation for both the dominant carrier and the new entrats; the commitment is to supply basic services (telephone, telex and telegraph) to all settlements with more than 300 inhabitants.

The PCS system

The first PCS networks in the Middle East might be operated in the Gulf countries and Israel in 97-98.

Domestic operators are turning to foreign partners with experience in the marketing processes, network operation, financial management and cellular infrastructures.
Motorola and Ericsson are the leading cellular infrastructure suppliers in Africa and in the Middel East. Siemens entered the market in 1995 by securing GSM contracts with Motorola. At the end of 1995 the three suppliers had secured 78% of the switching market and 72% of the base station market. Northern Telecom accounted for 10% of each market due to its presence in Israel. Alcatel is trying to work its way into the Africa and Middle East market.

Implementation of radio communications. Some Case Studies

Case Study 1 - WLL in Indonesia

National regulation: the existing scenario
The Ministry of Tourism, Posts and Telecommunications (MTPT) is the main policy making authority in the indonesian telecom industry. Within the MTPT, the Secretary General formulates general telecom plans while the Directorate General of Posts and Telecommunications (DGPT) turns these into operational policies. The DGPT is responsible for policy implementation, licensing issues, equipment specifications, technical standards and frequency management.

The Competitors present in the market
PT Telkom is the domnant operator offering fixed local and domestic long distance telephone services. Basic services liberalization in Indonesia gave rise to joint ventures or operating agreements between Telkom and private operators.
In 1996, Telkom was given the exclusive right to provide local fixed and fixed wireless telecommunications services nationwide for a period of 15 years. Domestic long distance services will remain the domain of Telkom for 10 years ahead.
PT Ratelindo, a joint venture between PTT Telkom and PT Bakrie Electronics Company, was established in 1993 to provide fixed wireless services. It received 10 Mhz of spectrum for fixed wireless in the AMPS A-band. However, it started commercial services in Jakarta. only in middle 1995 as negotiations over frequency allocation delayed the operation of the system.
Other operators in the market (operating agreement with Telkom) are:
Bukaka Singtel (403000 lines)
Daya Mitra Malindo (237000 lines)
Mitra Global Telekomunikasi (400000 lines)
PT Aria West (500000 lines)
PT Pramindo Ikat Nusantra (516000 lines)

Spectrum allocation
Until recently only Telkom and Ratelindo were permitted to operate WLL systems. With the award of the Joint Operations Scheme in 1995, the government liberalized the operations of WLL and any carrier is currently allowed to implement this technology.

Factors which oriented the choice of suppliers
The three main factors which were driving the choice, were:
to establish an early and profitable cash-flow;
the flexibility of selecting demand and connect subscribers accordingly;
the possibility of using,, initially, WLL in urban areas and later move the systems to rural areas.

Suppliers
Vendors include Alcatel, Ericsson, Lucent and NEC. They have been selected with reference to purchasing price, performance, terms/conditions of delivery.
NEC price is approximately $1000 per line; some suppliers, including Ericsson and Alcatel, however, seem to have slashed prices to $800 and $625 per line in recent contracts.

Performances
PT Aria West is very satisfied with the performance of NEC's WLL systems, which it claims have provided copper-equivalent service. The fax/data transmission rate is 9.6 Kbps.
Aria West's customers are typically residential, and some have waited as long as fiv years for a telephone.

Future deployment plans
According to its schedule, WLL will account for roughly 20% of Aria West's 500000 lines requirement during the first three years of its license. As a results the operator has no plan to purchase more WLL systems once installation of 97000 PHS lines from NEC is completed.

Case Study 2 - WLL in Argentina

National regulation: the existing scenario
The Comisiòn Nacional de Telecomunicaciones (CNT) is the Telecom Regulatory Authority in Argentina. The CNT is charged to control that TASA, TELECOM and TELINTAR meet their respective concession obligations. The CNT also grants licenses and operating permits, allocates radio frequencies and approves all telecommunications equipment and materials.

The WLL competitors present in the market
Telefonica de Argentina (TASA) was formed as a result of the privatization of the former state-run company, Empresa Nacional de Telecomunicaciones (ENTel) in 1990. TASA provides service in the southern region of Argentina and its concession covers 53% of the country including half of the city of Buenos Aires. The population within its coverage area was 16,9 million at end of 1995.
TELECOM also was created as a result of the privatization of ENTel in 1990. TELECOM holds a license to operate fixed-telephone services in the northern region of Argentina; the service is given to approximately the same population (16,5 million) including part of Buenos Aires.
Argentina has currently five cellular operators (Movicom and Movistar in great metropolitan Buenos Aires, CTI and CCPI in the northern part of the country and CTI and TCP in the south) which are not allowed to provide fixed wireless services.

Spectrum allocation
TASA and TELECOM are authorized to use the 1910-1930 Mhz, 3425-3430 Mhz and 3475-3480 Mhz bands for WLL. Each band must be used in different geographic zones.

The other companies min the market have been allocated the 800 Mhz band for mobile services in its regional coverage area together with the commitment to move to digital technology.

The key factors orienting the choice of suppliers

To TASA, the main factor for choosing WLL was the easy installation of the system, provided that it intended to extend service, in the very short run, to areas with no existing copper or outside plant..
Price will be the key factor in determining TASA's future WLL deployment plans. Tadiran's system, which costs about $1250 per line is comparable to the cost of a copper wire solution.. Competitive advantage was not a factor in the WLL selection since TASA has a monopoly within its region.
TASA is not currently using WLL for rural applications.

Standards

TASA chose from Tadiran because a system le to operate in the 3425-3430 Mhz and 3475-3480 Mhz bands. At the time spectrum was not available for CDM, DECT or cellular-based standards.
PHS was tested but there were problems in the interface with public phones: TASA billing system requires 16 Khz pulses between payphones and the central office, which TASA says was not possible using PHS.
TASA anticipated that DECT frequencies and 900 Mhz cellular will become available in the future.

Performances

Voice quality and fax capabilities for the Tadiran system were considered "acceptable". TASA is not allowed to provide data communication services. TASA offer Group3 fax capabilities to WLL subscribers.

Future plans

TASA has not established any definite plan regarding WLL future development. Its plans seem to line upwith the development of regulatory policy regarding allocation of spectrum. TASA hopes that the appropriate frequencies will become available for more open standards. TASA cites reduced costs, economies of scale and terminals interoperability as key advantages of DECT and other open standards.
TASA is, as well, interested in WLL systems tof extend coverage in rural areas.

Case Study 3: WLL in Hungary

National regulation: the existing scenario

The Ministry of Transport, Communications and Water Management (MTCW) governs Hungary's Telecommunication sector. An additiona Regulatory Body, the Chief Communications Inspectorate (CCI), under ministry's jurisdiction, is charged with the allocation of radio spectrum, licensing operators,granting the approval of equipment , monitoring the quality of service..
In 1993 the MTCW awarded 17 local operating concessions, creating a group of small independent telcos; there are now five holding companies controlling the 17 local concessions.

The WLL competitors present in the market

MATAV owns and operates almost all of Hungary's public-switched telephone network and controls all of Hungary's long distance and international network, as well as local networks in 39 of the country's 54 regions. MATAV was privatized in December 1993 and is 67%-owned by MagyarCom a consortium of Deutsche Telekom and Ameritech.
Deltav, owned by the French consortium Compagnie Generale des Eaux, is one of Hungary's independent local telecommunications operator and currently operates about 90000 lines.
Hungartel and **PapaTel** are local concessions owned by the holding company, Citizens Utility.

Spectrum allocation

Spectrum has been allocated on a case-by-case basis for WLL applications to the following operators:
MATAV has been granted acces to the 890-897,5 Mhz and 935-942,5 Mhz bands.
Deltav uses frequencies in the 1880-1990 Nhz band within its concession area.
Hungarteland PapaTel utilize bandwith in the 1880-1990 range.

The key factors orienting the choice of suppliers
To MATAV , the main factor for choosing WLL was price. Motorola system, at approximately $500-$600 per line provided a significant cost savings over a copper wire solution. The need for rapid deployment was another key factor in MATAV's selection of WLL technology.
According toMATAV: site preparation requires about one month, base station installation typically requires five months, and terminal installation takes another month. MATAV used its own people to install the WLL systems, with support from Motorola on network design.
Since MATAV does not face competition in any of its local concession areas, competitive advantage was not a key point and voice quality and data capabilities were not critical to the decision.
MATAV chose an analog cellular-based WLL system for large coverage area, rural location and dispersed population of Eastern Hungary, where the majority of WLL systems are being installed.

Standards
MATAV chose TACS because this was the best standard available in the 890-897,5 Mhz and 935-942,5 Mhz bands which were assigned for WLL. MATAV's frequency assignement only permitted the use of analog WLL systems in these bands.

Performance
The Motorola TACS system provides "acceptable" voice quality but does not seem to offer copper equivalent quality. Static noise was evident on both the NMT900 and TACS systems that MATAV trialed. According to MATAV better voice quality can be obtained by deploying WLL terminals with higher field strength. If the units are underpowered then voice quality suffers significantly.
MATAV's WLL network provides fax transmission at 9,6 Kbps and data at 7,2 Kbps.

Future development
MATAV has no specific plans for procuring WLL systems, but will begin evaluating CDMA WLL in 1997. MATAV wants a system able to provide ISDN, high data rates, and PCM 30 connections.

Conclusions

Two sets of conclusions are given. The first one deals with the considerations that can be derived from the general survey in four Regions in the World about the development of radio communications; the second one summarizes the approaches taken by selected Operators.

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.

The wireless technology. According to the survey it seems that no leading technology can be identifies in the Teleommunications 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 towadrs 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 case studies
The case studies demonstrate that the potential of wireless systems lies very much on the **regulatory strategies**. Regulatory authorities, in all cases, established guideliness for WLL deployment, designated operators to provide WLL services, and allocated adequate spectrum.

Privatization and liberalization contributed to WLL development in all case studies: WLL appears to be a good solution in liberalized market environments where its advantages (rapid deployment, cost savings and flexibility) are of interest to new carriers or privatized PTTs.

WLL **competes for spectrum** with other wireless applications, particularly cellular (450, 800, 900, 1900 Mhz) trunked mobile radio and digital microwave. As a result, the frequencies available for WLL vary from country to country, so that Regulators should move into higher bands (2-10 Ghz).

Easy installation and rapid delpoyment were cited by all operators as important reasons for choosing WLL. For new operators (Aria West and ATL) this was an important means of generating cash-flow, whereas MATAV and TASA were driven by the need to fulfill rural obligations.

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.

Critical issues to the progress of WLL system

- inadequate allocation of spectrum and delay in licensing operators
- WLL system prices did not drop down as quickly as expected
- WLL did not always help serving sparsely populated rural areas
- the lack of industry standards did not drive correctly the choices of Operators
- limited data/fax transmission rate reduced the competitive advantage of WLL
- voice quality is not always equivalent to copper/fibre

Asia&Pacific region: past and expected development

(11 countries selected; 2,7 billion population in 1996)

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Eastern Europe: past and expected development

(8 countries selected; 300 millions population in 1996)

Years	Telephone	cellular	PCS	cellular/tph
1994	15,85%	0,10%	0,00%	0,57%
1995	16,96%	0,20%	0,00%	1,09%
1996	18,46%	0,30%	0,00%	1,75%
1997	20,07%	0,50%	0,02%	2,52%
1998	21,79%	0,80%	0,07%	3,46%
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1997	11,16%	1,90%	0,06%	16,70%
1998	12,10%	2,40%	0,19%	20,23%
1999	12,96%	3,10%	0,43%	24,12%
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Africa/Middle East: past and expected development

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1995	7,48%	0,90%	0,00%	5,55%
1996	8,08%	1,50%	0,00%	8,94%
1997	8,73%	2,10%	0,04%	11,26%
1998	9,43%	2,80%	0,12%	13,83%
1999	10,17%	3,50%	0,21%	16,38%
2000	10,9%	4,96%	0,03%	21,47%

Case study 1. WLL in Indonesia

National regulation:	*Ministry of Turism&PT, Directorate General PT*
Competitors:	*PT Telkom,PT Ratelindo*
The choices:	*Early & profitable cash-flow* *Selected users conneted* *initial use in urban areas*
The suppliers:	*Alcatel, Ericsson, Lucent, NEC*
Performances:	*copper equivalent service* *data transmission 9,6 kbps*
Future Plans:	*none at present*

Case study 2. WLL in Argentina

National regulation:	*Comision Nacional de Telecomunicaciones*
Competitors:	*Telefonica de Argentina, Telecom*
The choices:	*Easy installation of equipment* *Price of systems*
The suppliers:	*Ericsson, Motorola, NEC, Northern Telecom*
Performances:	*voice quality acceptable* *no data transmission*
Future Plans:	*favour prospects for PCS international* *expand service in rural areas*

Case study 3. WLL in Hungary

National regulation:	***Ministry TCW, Chief commun Inspectorate***
Competitors:	***MATAV, Deltav, Hungartel, Papatel***
The choices:	***voice quality*** ***price of systems*** ***provision to rural areas***
The suppliers:	***Ericsson, Motorola, NEC, Northern Telecom***
Performances:	***voice quality acceptable*** ***data transmission 7,2 Kbps; fax 9,6 Kbps***
Future Plans:	***no specific plan***

CONCLUSIONS

From the survey:

- Regulatory issue
- The leading wireless technology
- Future expansion of WLL

From Case Studies:

- regulatory strategies
- privatization & liberalization
- spectrum availability
- easy installation
- rapid development