

**STUDY ON THE INTERNATIONAL MARKET  
FOR DIGITAL COMMUNICATIONS –  
EXPORT OPPORTUNITIES FOR EU COMPANIES.**

Final Report

01/09/1998

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**The opinions expressed in this Study are those of the authors and do not necessarily reflect the views of the European Commission**

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## Contents

<b>EXECUTIVE SUMMARY .....</b>	<b>5</b>
1.1. INTRODUCTION.....	6
1.2. DEPLOYMENT OF DIGITAL COMMUNICATIONS THROUGHOUT THE WORLD .....	7
1.2.1. <i>Regulatory and political environment</i> .....	7
1.2.2. <i>Technologies and Markets</i> .....	8
1.3. THE GLOBAL MARKET FOR DIGITAL MOBILE COMMUNICATIONS: IDENTIFICATION OF OPPORTUNITIES AND CONSTRAINTS.....	13
1.3.1. <i>Cellular telephony</i> .....	13
1.3.2. <i>Paging services</i> .....	13
1.3.3. <i>Cordless telephony and wireless local loop</i> .....	20
<b>MAIN REPORT .....</b>	<b>22</b>
<b>1. PREFACE.....</b>	<b>23</b>
<b>2. INTRODUCTION .....</b>	<b>25</b>
2.1. BACKGROUND OF THE STUDY.....	25
2.2. TERMS OF REFERENCE.....	25
2.2.1. <i>Objectives of the study</i> .....	25
2.2.2. <i>Scope of the study</i> .....	26
2.3. METHODOLOGY .....	26
2.3.1. <i>Approach</i> .....	27
2.4. REPORT STRUCTURE.....	27
<b>3. DEPLOYMENT OF DIGITAL COMMUNICATIONS IN EUROPE .....</b>	<b>29</b>
3.1. WESTERN EUROPE .....	27
3.1.1. <i>Summary</i> .....	29
3.1.2. <i>Regulatory and institutional environment</i> .....	32
3.1.3. <i>Market environment</i> .....	34
3.1.4. <i>Conclusions</i> .....	44
3.2. CENTRAL AND EASTERN EUROPE.....	45
3.2.1. <i>Summary</i> .....	45
3.2.2. <i>Political relation and environment</i> .....	47
3.2.3. <i>Regulatory and institutional environment</i> .....	47
3.2.4. <i>Market environment</i> .....	48
3.2.5. <i>Conclusions</i> .....	52
<b>4. DEPLOYMENT OF DIGITAL COMMUNICATIONS IN NORTH AMERICA, ASIA-PACIFIC, LATIN AMERICA AND MIDDLE-EAST/AFRICA.....</b>	<b>53</b>
4.1. MOBILE COMMUNICATIONS IN NORTH AMERICA.....	53
4.1.1. <i>Summary</i> .....	53
4.1.2. <i>Political relation and environment</i> .....	55
4.1.3. <i>Market Environment</i> .....	55
4.1.4. <i>Conclusions</i> .....	64

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4.2.	MOBILE COMMUNICATIONS IN ASIA PACIFIC .....	65
4.2.1.	<i>Summary</i> .....	65
4.2.2.	<i>Regulatory and institutional environment</i> .....	68
4.2.3.	<i>Market environment</i> .....	69
4.2.4.	<i>Conclusions</i> .....	75
4.3.	MOBILE COMMUNICATIONS IN LATIN AMERICA .....	76
4.3.1.	<i>Summary</i> .....	76
4.3.2.	<i>Political relation and environment</i> .....	78
4.3.3.	<i>Regulatory and institutional environment</i> .....	81
4.3.4.	<i>Market environment</i> .....	81
4.3.5.	<i>Conclusions</i> .....	86
4.4.	MOBILE COMMUNICATIONS IN MIDDLE EAST – AFRICA .....	87
4.4.1.	<i>Summary</i> .....	87
4.4.2.	<i>Political and institutional environment</i> .....	90
4.4.3.	<i>Regulatory environment</i> .....	91
4.4.4.	<i>Market environment</i> .....	92
4.4.5.	<i>Conclusions</i> .....	97
<b>5.</b>	<b>THE GLOBAL MARKET FOR DIGITAL MOBILE COMMUNICATIONS: IDENTIFICATION OF OPPORTUNITIES AND CONSTRAINTS.....</b>	<b>98</b>
5.1.	INTRODUCTION.....	98
5.2.	CELLULAR TELEPHONY SERVICES .....	98
5.2.1.	<i>Market demand</i> .....	98
5.2.2.	<i>Technological evolution</i> .....	102
5.2.3.	<i>Companies' strategies</i> .....	111
5.3.	PAGING SERVICES.....	114
5.4.	CORDLESS TELEPHONY AND WIRELESS LOCAL LOOP MARKETS .....	117
5.5.	EVOLUTION OF REGULATORY AND POLITICAL ENVIRONMENT .....	122
5.5.1.	<i>Potential impact of international agreements</i> .....	125

**LIST OF TABLES AND CHARTS**

<i>World presence of GSM family standards (GSM-900, DCS-1800, PCS-1900)</i> .....	9
<i>Presence of non European companies into European cellular operators' capital</i> .....	33
<i>Telecommunication services in value, by sector in Western Europe</i> .....	34
<i>Evolution of the telecom services market in Western Europe by sector</i> .....	35
<i>Telecommunication service subscribers by sector in Western Europe</i> .....	35
<i>Western Europe : cellular subscribers and cellular teledensity</i> .....	36
<i>Cellular subscribers in Western Europe: digital versus analogue</i> .....	36
<i>Cellular subscribers in Western Europe: 1997 country split</i> .....	37
<i>The GSM success factors model</i> .....	38
<i>Paging subscribers in Western Europe</i> .....	39
<i>The ERMES success factors model</i> .....	41
<i>The DECT success factors model</i> .....	43
<i>Evolution of the telecom services market in Central and Eastern European countries by sector</i> .....	48
<i>Evolution of the telecom services market in Central and Eastern European countries by sector</i> .....	48
<i>Central and Eastern European countries : cellular subscribers and cellular teledensity</i> .....	49
<i>Evolution of the telecom services market in North America by sector</i> .....	56
<i>Telecom services subscribers by sector in North America</i> .....	58
<i>North America : cellular subscribers and cellular teledensity</i> .....	58
<i>The US Paging market</i> .....	61
<i>The top 10 paging operators</i> .....	62
<i>Evolution of the telecom services market in Asia-Pacific by sector</i> .....	69
<i>Evolution of the telecom services infrastructure in Asia-Pacific</i> .....	70
<i>Digital technologies in Asia-Pacific</i> .....	71
<i>Status of telecommunication regulation in Latin America</i> .....	81
<i>Evolution of the telecom services market in Latin America by sector</i> .....	82
<i>Evolution of the telecom services infrastructure in Latin America</i> .....	82
<i>Evolution of the telecom services market in Africa-Middle East by sector</i> .....	92
<i>Evolution of the telecom services infrastructure in Africa-Middle East</i> .....	93
<i>The Middle East – Africa fixed network</i> .....	94
<i>Evolution of the number of cellular subscribers by geographical area (in millions)</i> .....	98
<i>Evolution of the world mobile services market by geographical area (\$ 1996, in billions)</i> .....	99



## **EXECUTIVE SUMMARY**

## 1.1. INTRODUCTION

At the end of 1997, it was estimated that 63 million of mobile telephony subscribers were connected to a GSM network. Three years from now, out of the estimated 300 million subscribers to mobile telephony services world-wide, 50% should be using GSM technology.

But that leading position is now challenged by other digital technologies and Europe is facing heavy competitive pressure from the USA and Japan in its attempt to make GSM and its next generation system the prominent technology for new cellular networks.

In the cordless arena, DECT is beginning to be more widely adopted, at least in Europe and several countries abroad, after experiencing a slow start. In the wireless local loop arena, DECT could also find market opportunities, especially in developing countries

On the paging side, ERMES has had a limited success in Europe until now. In the meantime however it has been adopted by a few non-European operators in the Middle East and Asia.

According to different market forecasts, business opportunities will grow quickly all around the world in the near future, and EU companies must seize most of them to keep their leadership role, but may need to be adequately supported by European bodies to lift potential barriers.

In this respect the DGXIII of the European Commission engaged the IDATE-EGIS consortium to undertake a world-wide study with the following **key objectives**:

- **give a comprehensive overview of the world-wide introduction and deployment of European digital mobile technologies and services;**
- **assess further opportunities for their export;**
- **describe the existing restrictions confronting European firms and how these can be lifted;**
- **And to provide recommendations as to how European industry and political instances can ensure further development of EU technologies on the world markets for digital mobile communications.**

Many of the findings in the report are based on the results of an interview programme carried out with about 40 senior representatives of major industry players (operators, equipment manufacturers) as well as international or industry organisations such as ETSI, UMTS forum, GSM MoU. Desk research has also been carried out to build an updated view of all regions considered in the report.

This executive summary is intended to give an overview of major findings gathered for this study including market trends, opportunities, constraints as well as major recommendations for action to ensure the future positioning of EU technologies and companies in an increasingly global market.

## 1.2. DEPLOYMENT OF DIGITAL COMMUNICATIONS THROUGHOUT THE WORLD

In less than twenty years, the world mobile telecommunications industry has succeeded in becoming the leading segment of global telecommunications in terms of growth rate. It is expected to represent more than half of the world-wide installed base of subscribers to fixed telecom services in less than 10 years from now. This section provides an overview of the markets from regulatory, technological and market points of views.

### 1.2.1. Regulatory and political environment

Regulatory situations still vary widely from one region to another: from the most liberalised markets (USA, Australia), to the very closed ones (like China). Generally speaking, all regions are moving rapidly toward deregulation and liberalisation as shown in the following table.

<b>Western Europe</b>	<ul style="list-style-type: none"> <li>- Progressive markets liberalisation until full competition on 1<sup>st</sup> January 1998 in most countries.</li> <li>- At least <b>two mobile operators in each country</b> (3 and more operators in most of them).</li> <li>- <b>Well defined technological choices</b> in cellular telephony (GSM), more open in paging and wireless local loop.</li> </ul>
<b>Central and Eastern Europe</b>	<ul style="list-style-type: none"> <li>- Separation between regulation and operations was the first step (Hungary 01/90; Poland 1990; Czech Rep. 1992).</li> <li>- <b>Mobile sector seen as a priority</b> to develop telecommunication infrastructure in the region.</li> <li>- <b>Several mobile licences awarded</b> to consortia partially owned by foreign investors.</li> <li>- From 1993: start of privatisations across several countries.</li> </ul>
<b>North America</b>	<ul style="list-style-type: none"> <li>- <b>Widely liberalised market for mobile</b> communications in the USA although regulation for the number and ownership of operators by market area still remains (notably no more than two cellular operators by area).</li> <li>- Cellular service licences awarded under the <b>'beauty contest'</b> process; PCS ones on <b>auction</b>.</li> <li>- Canadian selection process based on the strengths of individual applications.</li> </ul>
<b>Asia Pacific</b>	<ul style="list-style-type: none"> <li>- Limited deregulation until 1993 and accelerating over the past few years.</li> <li>- <b>Mobile communications</b> sector now <b>open to competition</b> in most countries.</li> <li>- Most regulators have adopted a <b>technology neutral approach</b>.</li> <li>- A great variety of regulatory situations: free competition in <b>Australia</b>; strong regulation in <b>China</b>; early move toward liberalisation in <b>Japan</b>; chaotic situations in <b>Malaysia and the Philippines</b> etc.</li> </ul>
<b>Latin America</b>	<ul style="list-style-type: none"> <li>- On going move of all countries toward liberalisation</li> <li>- <b>Implementation of competition or duopoly regime</b> for wireless communications in largest countries.</li> <li>- All Latin American regulators adopted the FCC model of deregulation at the end of the 80s.</li> <li>- <b>Technology neutral approach for PCS</b> licences.</li> </ul>
<b>Middle East – Africa</b>	<ul style="list-style-type: none"> <li>- Telecommunications still largely under administrative and political control.</li> <li>- Telecommunication reforms also depend on the liberalisation of the national</li> </ul>

economy.
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### 1.2.2. Technologies and Markets

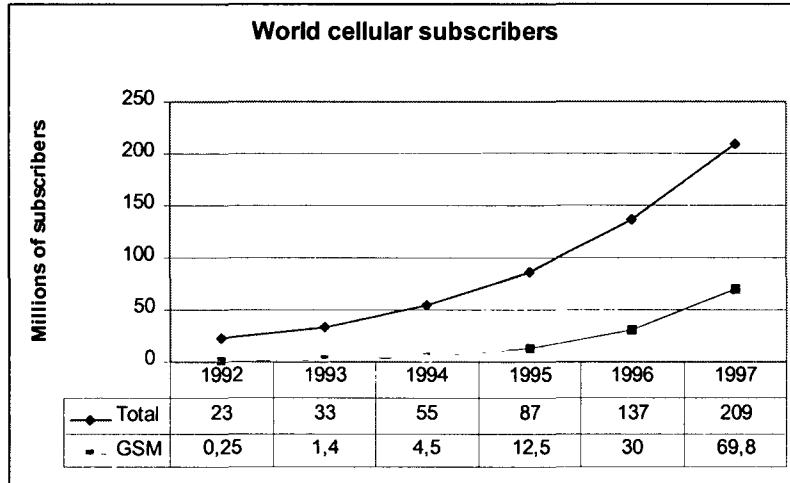
#### Digital Cellular Telephony

Thanks to several factors, GSM is now present on five continents, with strong presence, outside Western Europe, in Eastern and Central Europe, Middle East / Africa and Asia Pacific regions. From a technological point of view, all regions (except Europe) are characterised either by the coexistence of several heterogeneous systems, or by a very recent move towards 2<sup>nd</sup> generation (Latin America notably).

<b>Western Europe</b>	<ul style="list-style-type: none"> <li>- All operators implemented GSM 900 or 1800</li> <li>- Main reasons of the GSM success have been: <ul style="list-style-type: none"> <li>- <b>the GSM MoU: co-ordinated actions from all players</b></li> <li>- <b>GSM: an open standard</b> right from the start</li> <li>- <b>Strong market demand</b> from end users</li> <li>- <b>Ahead of competing technologies</b></li> <li>- Robust end to end technical solution</li> <li>- <b>Early licensing</b></li> <li>- <b>Strong political goal</b> to create a unified market within the European Union.</li> </ul> </li> </ul>
<b>Central and Eastern Europe</b>	<ul style="list-style-type: none"> <li>- NMT-450 was the first cellular technology</li> <li>- GSM networks now represent 2/3 of the market</li> <li>- CDMA trials in Poland, and commercial networks in Russia.</li> </ul>
<b>North America</b>	<ul style="list-style-type: none"> <li>- <b>Several standards</b> for digital cellular networks: PCS 1900 (GSM), IS-95 CDMA, IS-136 TDMA,</li> <li>- <b>Technology heterogeneity</b> often maintained as a marketing weapon to reduce churn.</li> <li>- Relatively <b>small interest in the next generation</b> of systems.</li> </ul>
<b>Asia Pacific</b>	<ul style="list-style-type: none"> <li>- <b>22 countries have operational GSM networks.</b></li> <li>- <b>GSM is absent from Japan</b>, where digital networks use PDC technology, and CDMA more recently.</li> <li>- <b>CDMA is making inroads</b> in several countries: Korea, Japan, Hong Kong, India, Indonesia, Philippines, Singapore, Thailand.</li> <li>- <b>Japan pushing hard</b> to move towards 3<sup>rd</sup> generation systems.</li> </ul>
<b>Latin America</b>	<ul style="list-style-type: none"> <li>- <b>Most networks are analogue</b>, based on AMPS standard.</li> <li>- <b>Two operators</b> (Chile, Paraguay) adopted the <b>GSM</b> standard</li> <li>- CDMA and IS-136 standard considered as a natural evolution of existing analogue networks toward second generation.</li> </ul>
<b>Middle East – Africa</b>	<ul style="list-style-type: none"> <li>- <b>GSM: leading digital technology</b> in the region (46% of the subscriber base in 1996)</li> <li>- <b>First CDMA based network</b> launched in Zambia in 1997. Five networks currently deployed in Kuwait and Yemen, Congo and Nigeria</li> </ul>

In just six years of commercial operations, GSM has become the dominant world digital wireless technology, a role which is expected to maintain into the 21<sup>st</sup> century, although, as shown on the following

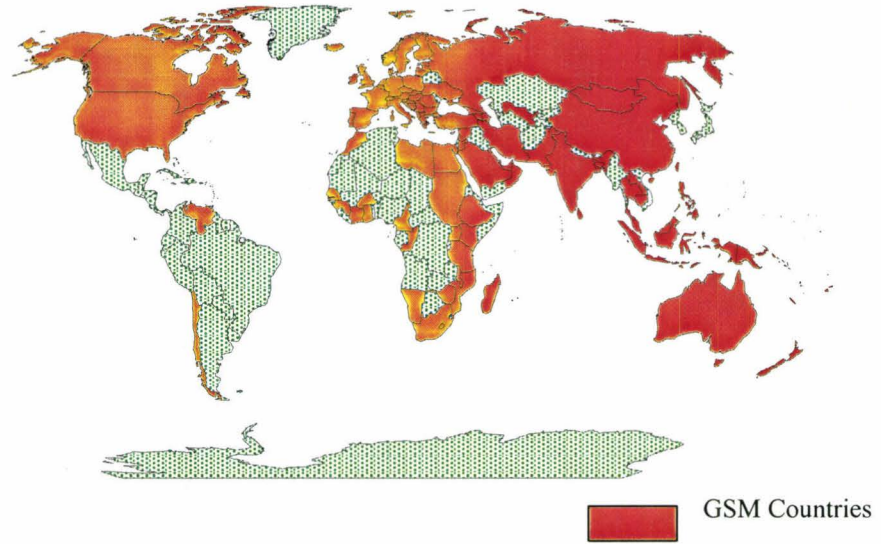
table, competing technologies should grab a growing share of the market in the coming years. The actual implementation of third generation systems (around 2001-2004) will mean increasing competitive pressure for EU companies from players wishing to be back on the market as soon as possible.



Millions of subscribers (digital technologies)	GSM (incl. DCS1800/ PCS1900)	Non European technologies
<b>Regions</b>		<b>1997</b>
Western Europe	46.3	0.0
Eastern Europe	2.6	0.0
North America	1.3	1.0
Latin America	0.0	2.0
Asia Pacific	16.5	33.2
Africa Middle-East	3.1	0.0
<b>Total</b>	<b>69.8</b>	<b>36.2</b>
<b>World total digital technologies</b>	<b>106.0</b>	<b>106.0</b>
<b>World Total (including analogue)</b>	<b>209.0</b>	<b>209.0</b>

Source IDATE - EGIS

**World presence of GSM family standards (GSM-900, DCS-1800, PCS-1900)**



**Paging**

Technologies available for paging services are not numerous. Most networks are still running analogue POCSAG standard, and many of them, notably in Europe, are far from saturation.

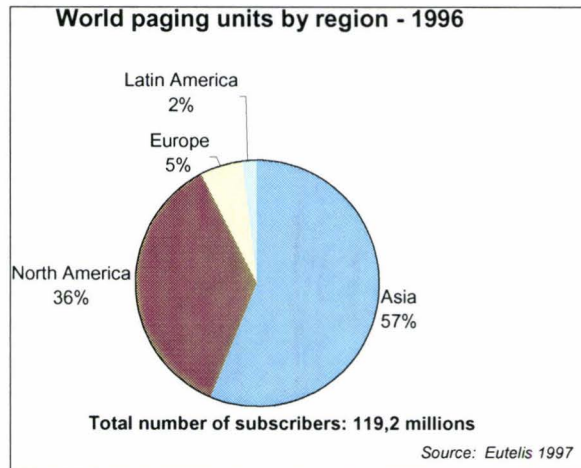
European ERMES or US FLEX (Motorola) are the two leading digital technologies for paging. Although being a proprietary solution, FLEX (and its associated systems such as ReFLEX and InFLEXION) are almost considered as a world de-facto standard. It has been adopted and implemented by 118 carriers in the 30 countries representing 80% of the world's subscriber base (notably the USA, China, Brazil, India, Indonesia, Japan, and Thailand).

ERMES has been adopted by about 30 countries (1 in Asia, 6 in Middle East, and 23 in Europe (Western and Eastern), 13 networks are commercially opened.

In 1996 120 million people subscribed to a paging service (analogue or digital) world-wide, of which 9 million were connected to digital networks (ERMES or Flex). The paging market in Europe is underdeveloped when compared with the rest of the world, especially North America and the Asia Pacific region.

Millions of subscribers (digital technologies)	ERMES	Non European technologies
Regions	1996	1996
Western Europe	0.5	0.0
Eastern Europe	0.0	0.0
North America	0.0	3.5
Latin America	0.0	0.0
Asia Pacific	0.0	4.5
Africa Middle-East	0.5	0.0
<b>Total</b>	1.0	8,0
<b>World total digital technologies</b>	9.0	9.0
<b>World Total (including analogue)</b>	120.0	120.0

Source IDATE – EGIS



**Cordless telephony and Wireless Local Loop**

While cordless telephony is starting to record high growth rates in most advanced countries, the market for Wireless Local Loop solution is more located in developing countries, where the state of the fixed network stimulate investment in wireless technologies. Thanks to increasing efforts of the DECT forum, which now has 42 members, the DECT technology is starting to take more significant market shares in the cordless telephony markets (residential and business) and is making noticeable inroads in the wireless local loop arena.

Contrary to cellular telephony, technologies available for cordless telephony and wireless local loop are numerous, and there is no trend towards standards unification.

	<b>Technologies</b>	<b>Markets</b>
<b>Western Europe</b>	<ul style="list-style-type: none"> <li>- <b>DECT leadership as digital cordless telephony</b> in residential and business markets.</li> <li>- <b>Difficult start for DECT as Cordless Terminal Mobility (CTM) technology</b></li> </ul>	<ul style="list-style-type: none"> <li>- <b>Cordless telephony is growing rapidly</b> in the region</li> <li>- WLL considered as the main solution for new entrants to compete with incumbent operator.</li> <li>- Cordless Telephone Mobility facing hard times following the Telecom Italia experience.</li> </ul>
<b>Central and Eastern Europe</b>	<ul style="list-style-type: none"> <li>- <b>Several different technologies implemented</b> (including, DECT, WiLL, ETACS and CDMA).</li> <li>- <b>World's largest installed base of WLL lines.</b></li> </ul>	<ul style="list-style-type: none"> <li>- <b>Cordless telephony not developed</b> in the region</li> <li>- <b>Very active region for WLL activity.</b></li> </ul>
<b>North America</b>	<ul style="list-style-type: none"> <li>- North American cordless telephony uses PCS "unlicensed" spectrum, around 1700 MHz.</li> <li>- <b>Canada mainly uses CT2 and Ericsson's CT3 technologies</b> for cordless.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>WLL not developed</b> and not expected to significantly grow in the future.</li> <li>- CT2 licences awarded in Canada to four operators, rapidly changed to PCS licences.</li> </ul>
<b>Asia Pacific</b>	<ul style="list-style-type: none"> <li>- <b>DECT presence is mainly in the WLL arena</b>, in the Philippines and Indonesia.</li> <li>- <b>DECT is perceived as a wireless PBX standard</b>, PHS is for public services in high density cities. The two technologies compete on the WLL field.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Malaysia and Indonesia are the most active countries for WLL.</b></li> <li>- Several on going trials in India and China</li> </ul>
<b>Latin America</b>	<ul style="list-style-type: none"> <li>- <b>DECT gained strength on the WLL market</b> and faces PHS as major competitor.</li> <li>- <b>Numerous proprietary systems coexist for WLL:</b> AirLoop (Lucent); GMH 2000 (Hughes); DIVA2000 (Diva); Multigain (Tadiran); AirSpan (DCS); WiLL (Motorola).</li> </ul>	<ul style="list-style-type: none"> <li>- <b>The need to rapidly expand fixed network</b> favours the development of WLL solutions.</li> </ul>



<b>Middle East – Africa</b>	<ul style="list-style-type: none"> <li>- Major contract for DECT in South Africa</li> <li>- Several on going trials using different technologies.</li> </ul>	<ul style="list-style-type: none"> <li>- Marginal business activity for residential cordless</li> <li>- WLL: activity restricted to trials and few contracts.</li> </ul>
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### 1.3. THE GLOBAL MARKET FOR DIGITAL MOBILE COMMUNICATIONS: IDENTIFICATION OF OPPORTUNITIES AND CONSTRAINTS

#### 1.3.1. Cellular telephony

##### Regulatory and political environment

Understanding the evolution of regulatory and political environments are key to highlight potential barriers to EU technologies and companies. Generally speaking, market liberalisation is progressing rapidly in all regions. Numerous new licences are expected to be awarded over the near future, representing major business opportunities for equipment suppliers. However at least three major factors could represent barriers to EU interests:

- the actual evolution of regulatory regimes for 3<sup>rd</sup> generation systems both within and outside Europe.
- The potential consequence of the deployment of NAFTA and FTAA agreements across the Americas
- The speed and actual implementation of WTO agreement in all signatory countries.

	Opportunities	Constraints/threats
<b>Western Europe</b>	<ul style="list-style-type: none"> <li>• Harmonisation of countries' regulatory regimes for 3<sup>rd</sup> generation.</li> </ul>	<ul style="list-style-type: none"> <li>• The short term need for a well defined and homogeneous regulatory regime for UMTS.</li> <li>• The actual set-up of a large and strong 'home' market.</li> </ul>
<b>Central and Eastern Europe</b>	<ul style="list-style-type: none"> <li>• Application of 10 countries to join EU.</li> </ul>	<ul style="list-style-type: none"> <li>• Possible delays in market liberalisation.</li> <li>• Need for regulatory and technical homogeneity (terminal type approval).</li> </ul>
<b>North America</b>	<ul style="list-style-type: none"> <li>• Full liberalisation of the market.</li> </ul>	<ul style="list-style-type: none"> <li>• The availability of frequencies for 3<sup>rd</sup> generation systems.</li> <li>• Political lobbying with WTO signatory countries.</li> </ul>
<b>Latin America</b>	<ul style="list-style-type: none"> <li>• Numerous licences to be awarded across the region, notably for PCS services.</li> <li>• Limited success of regional trade agreements.</li> <li>• Development of trade relations between Mercosur and EU.</li> </ul>	<ul style="list-style-type: none"> <li>• The actual implementation of FTAA and NAFTA agreements</li> <li>• Wide US political and financial influence across the region.</li> <li>• The actual implementation of WTO agreements.</li> </ul>
<b>Asia Pacific</b>	<ul style="list-style-type: none"> <li>• The creation of a regional standardisation body (ATSI).</li> <li>• Fast move towards market liberalisation and deregulation.</li> </ul>	<ul style="list-style-type: none"> <li>• The increasing driving role of Japan in the region</li> <li>• The Chinese situation vs. WTO.</li> <li>• The actual implementation of WTO</li> </ul>

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		agreements.
<b>Middle East / Africa</b>	<ul style="list-style-type: none"> <li>• The actual implementation of the African Green Paper.</li> <li>• Privatisation and liberalisation spread throughout the region.</li> </ul>	<ul style="list-style-type: none"> <li>• Most regulators remains under government control.</li> <li>• The actual speed of implementing reforms.</li> </ul>

**Technologies and Markets**

Many market opportunities are expected to result from technological evolution of current generation of systems, and move towards the next generation. The latter could represent both major opportunities and threats to EU companies: opportunities as 3<sup>rd</sup> generation systems are expected to end up with much more compatible systems across the regions, thus enlarging addressable markets; threats, if final standards are not so much compatible, and as that move will allow new competitors, notably Japanese ones, to catch back on market leaders.

On the other hand, if 3<sup>rd</sup> generation systems will represent, at least for the radio part, a technological revolution, actual market deployment is expected to be much more progressive, and as a complement to existing infrastructure on niche markets in the short term, as long as applications are ready to stimulate market demand.

	Opportunities		Constraints / threats
	2 <sup>nd</sup> Generation	3 <sup>rd</sup> Generation	
<b>Western Europe</b>	<ul style="list-style-type: none"> <li>• New releases of GSM.</li> <li>• Remaining GSM 1800 licences to be awarded</li> <li>• Data communications capabilities.</li> </ul>	<ul style="list-style-type: none"> <li>• Migration toward 3<sup>rd</sup> generation systems.</li> </ul>	<ul style="list-style-type: none"> <li>• The need of a homogeneous move toward 3<sup>rd</sup> Generation.</li> <li>• The actual market demand for new services.</li> <li>• The strength of US networking companies in IP based equipment.</li> <li>• 3<sup>rd</sup> generation IPRs.</li> </ul>
<b>Central and Eastern Europe</b>	<ul style="list-style-type: none"> <li>• Market leadership of western European technologies.</li> <li>• Additional GSM 1800 licences in 10 countries applying to enter EU.</li> </ul>		
<b>North America</b>	<ul style="list-style-type: none"> <li>• Rapid deployment of PCS1900 based networks</li> <li>• Growing number of members to the GSM Alliance.</li> </ul>	<ul style="list-style-type: none"> <li>• No existing barriers for UMTS as preferred 3<sup>rd</sup> generation solution.</li> </ul>	<ul style="list-style-type: none"> <li>• Rapid deployment of competing technologies (CDMA/TDMA) supported by 4 major equipment suppliers.</li> <li>• IMT-2000 frequencies already partially awarded to PCS operators.</li> </ul>
<b>Latin America</b>	<ul style="list-style-type: none"> <li>• Adoption of GSM in Chile and Paraguay.</li> </ul>		<ul style="list-style-type: none"> <li>• Market leadership of US standards for PCS networks (notably Brazil and Mexico).</li> <li>• Need for cross-border compatibility of standards.</li> </ul>
<b>Asia / Pacific</b>	<ul style="list-style-type: none"> <li>• Strong presence of GSM across the region.</li> <li>• New releases of GSM.</li> </ul>	<ul style="list-style-type: none"> <li>• Closer relationships developed with Japan for 3<sup>rd</sup> generation works.</li> <li>• Short term needs in</li> </ul>	<ul style="list-style-type: none"> <li>• Growing number of CDMA based networks.</li> <li>• Move towards not compatible 3<sup>rd</sup> generation</li> </ul>

		Japan.	standards.
<b>Middle East / Africa</b>	• Official adoption of GSM by the Arabian League.		

Over the last ten years, the world market for mobile communications recorded growth rates, which any industry experienced before. For the foreseeable future, such a trend is expected to at least continue or even accelerate, as most countries are still far from maximum penetration rates.

Regarding the evolution of subscribers, we estimate that by the end 2001 about 450 million people will be subscribing to a cellular telephony service, tripling the 1996 installed base, and that five years later, this figure will almost double, with 400 million more joining the "club".

	Market ( billions)			Subscribers (millions)		
	1996	2001	2006	1996	2001	2006
Western Europe	\$29.8	\$70.0	\$97.5	35.3	125.2	224.1
Central and Eastern Europe	\$2.5	\$20.8	\$42.0	1.5	24.6	75.1
North America	\$20.4	\$46.6	\$63.6	47.7	96.2	138.4
Asia Pacific	\$42.6	\$69.5	\$92.7	40.6	136.8	220.3
Latin America	\$11.3	\$43.6	\$78.0	6.8	51.6	139.6
Middle East – Africa	\$6.3	\$23.4	\$39.3	3.8	14.2	52.4
<b>Total</b>	<b>\$112.9</b>	<b>\$272.9</b>	<b>\$413.1</b>	<b>135.7</b>	<b>448.6</b>	<b>849.9</b>

Source IDATE

The main criteria influencing the evolution of the market can be summarised as follows:

- **growing number of new networks:** all countries will have at least two or three operators.
- **growing size of networks:** from few thousands to millions of subscribers, means a strong need to expand the network capacity as well as coverage.
- **growing need for services:** the need for market differentiation, leads to development of new functionalities, integrating more multimedia capabilities
- **competing with fixed line:** in many cases mobile communications are a faster and cheaper way to start solving waiting list problems.
- **On the handsets side,** the total number of digital handsets is expected to go from about 60 million units in 1996 to more than a hundred millions units per annum over the 1998-2002 time frame.

	Opportunities	Constraints / Threats
<b>Western Europe</b>	- Continuous growth of subscribers' base. - Evolution toward third generation systems.	<b>Uncertainties about market expectations for new services (3<sup>rd</sup> generation).</b>
<b>Central and Eastern Europe</b>	- Lack of fixed networks. - Need for modern telecom infrastructures.	- Weak economies - Low GNP/inhabitant
<b>North America</b>	- Continuous growth of subscribers. - Slow migration toward digital systems.	<b>Hard competitive pressures,</b> requiring large investment to keep leadership and differentiation on products.
<b>Latin America</b>	- Huge potential and expected growth of subscribers, - Rapidly developing economies. - Lack of fixed networks.	- LOW GNP/INHABITANT - Domination of US standards.

<b>Asia / Pacific</b>	- World's largest potential market. - European technologies and companies widely present.	- Economic level of several countries will slow market evolution. - Increasing competitive pressures from Japanese companies.
<b>Middle East / Africa</b>	- Market concentrated on few rich enough countries.	<b>Economic weakness</b> and political instability.

### Companies' strategies

#### Equipment manufacturers

Thanks to the GSM standard strengths, EU equipment suppliers currently have a leading or strong presence on almost all the world's markets (except Japan) both for terminal and network infrastructure equipment. However, **market demand and regulatory constraints are driving their strategies. Generally speaking, they want to be able to provide any system for which they think there is or there will be a market.**

- Swedish **Ericsson** decided to develop products in every technology (except IS 95 CDMA and PHS), in order to be able to address any market directly (Ericsson is the only European manufacturer having a strong presence in Latin America)
- **Nokia**, the Finnish manufacturer, is mainly concentrating on the GSM Family type of products, but also developed its presence in Japan through a joint venture to sell PDC terminals and more recently decided to develop a line of terminals using the CDMA technology.
- **Alcatel and Siemens**: decided to address aggressively mobile communications markets, later than the others. Both of them are primarily focusing on the GSM markets. However, to be present on others' technologies markets, they have concluded strategic alliances with other manufacturers: Alcatel signed an open co-operation agreement with Motorola to have a CDMA offering, and with Hughes Network Systems for D-AMPS systems.
- American manufacturers **Motorola, Nortel and Lucent Technologies** are selling GSM, CDMA and TDMA systems depending on region.
- On the terminal side, the recent joint venture between **Philips** and Lucent Technologies will open the North American market and standards to the Dutch manufacturer, while an increasing number of Japanese companies are now manufacturing GSM terminals notably in Europe.

The move towards a new generation represents a major challenge to all manufacturers, with associated opportunities and threats. Generally speaking, for the time being, all manufacturers are pushing towards standards having maximum compatibility across the world (to ensure volume markets). To do so Ericsson and Nokia joined Japan's 3rd generation cellular project early. This highly contributed to the closer co-operation now established between ETSI and ARIB, and to ensure the high positioning of UMTS within the future IMT 2000 framework.

#### Operators

Generally speaking, European operators' policy is not necessary to support European technologies or standards more than others. They are rather inclined to follow respective local operators' or regulators' decisions.

However, apart from the Telefonica case in Latin America, no European operator acquired a significant equity share in an operator running a non European standard based network.

Among European operators, it is perhaps Deutsche Telekom that is the most active in promoting GSM in the Asia Pacific region. Deutsche Telekom is also the only European company really pushing for GSM to be adopted in Japan, as a different service compared with the one offered by Japanese operators that focus their marketing on terminals.

Indeed, also of importance is C&W 54% stake in Hongkong Telekom, the market leader in mobile phone services, that offers GSM services. C&W and Hong Kong Telecom also jointly invested in Singapore's new operator MobileOne Asia (M1),

More recently, some European operators have started to back NTT DoCoMo's third generation cellular. Telecom Italia Mobile announced it would jointly work with NTT DoCoMo on making the Japanese system compatible with GSM, in a new format to be proposed to standardisation bodies.

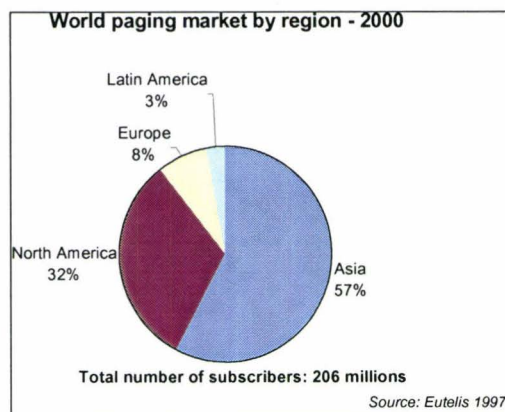
In Latin America, Telefónica leads the field. Since the beginning of the 1990s, the Spanish operator has pursued an international expansion policy through its subsidiary TISA (Telefonica Internacional S.A.), set up specifically for this purpose and which now accounts for 16% of group turnover and more than 20% of its profits.

Other European operators are also showing interest in the Latin American market, especially STET and France Télécom.

However most of them are mainly involved in fixed telecom operations, and none of them has been specifically pushing European technologies for mobile networks.

### 1.3.2. Paging Services

The market for paging services in general is expected to record a significant growth in the medium and longer term. According to a study on the world paging market done by Eutelis, the paging subscriber base was 119.2 millions at the end of 1996. That number is expected to roughly double over the next 4 years until the end of 2000, to reach 206 million subscribers.



**Key market drivers:**

- **Competition:** in the fastest growing markets, competition between national operators has been the driving force behind paging growth.
- **Competitive standards:** paging services have to position themselves as a low end solution compared to cellular and PCS services, requiring to have very competitive costs, Low costs can be obtained from widely developed standards generating large volumes.
- **Spectrum availability:** The move towards more data intensive, higher functionality applications such as email, will affect the channel capacity. Operators will have to migrate to digital standards (Flex or ERMES) but in the longer term, the spectrum shortage could become the major barrier to market development.

	Opportunities	Constraints / Threats
<b>Western Europe</b>	<ul style="list-style-type: none"> <li>• Market expected to triple within 4 years.</li> </ul>	<ul style="list-style-type: none"> <li>• About 50% of operators want to use the Flex technology.</li> <li>• Decreasing rates in several countries.</li> <li>• Competition from cellular networks.</li> </ul>
<b>Central and Eastern Europe</b>	- none	Underdeveloped market
<b>North America</b>	<ul style="list-style-type: none"> <li>• Large and growing market for paging services.</li> </ul>	<ul style="list-style-type: none"> <li>• ERMES completely absent.</li> <li>• Market leadership of Flex for digital paging.</li> <li>• Competition from cellular networks.</li> <li>• Need for additional spectrum for new services.</li> </ul>
<b>Latin America</b>	<ul style="list-style-type: none"> <li>• Market to grow from 2.4 to more than 6 million subscribers.</li> </ul>	<ul style="list-style-type: none"> <li>• Small market</li> <li>• Very important US influence for standard choice.</li> </ul>
<b>Asia / Pacific</b>	<ul style="list-style-type: none"> <li>• World's largest market for paging services, expected to about double within 4 years.</li> </ul>	<ul style="list-style-type: none"> <li>• One country adopted ERMES.</li> <li>• Flex now considered as a de-facto standard in the region.</li> <li>• Competition from cellular networks.</li> <li>• Need for additional spectrum for new services.</li> </ul>
<b>Middle East / Africa</b>	none	• Underdeveloped market.



### 1.3.3. Cordless telephony and wireless local loop

1997 was a successful year for DECT. A large number of countries throughout the world allocated frequencies for DECT, and operators installed both private and public systems. In 1997 alone the number of DECT units sold approached 10 millions, exceeding the cumulated sales of previous years.

Until recently, DECT has been most widely used in applications where it has more specifically been designed for: in residential and business environments. Wireless local loop are emerging as another key area, with public access services based on DECT still in their infancy.

Europe was DECT's birthplace, but DECT is now sold on a world-wide scale. According to Dataquest, the world annual market for DECT handsets for residential and in-building business applications is expected to grow from about 4 million units in 1997 to 13 millions in 2001.

#### DECT preferred technology for business applications

From a market segment point of view, DECT is established as the preferred cordless technology for business applications with different product types serving different applications.

#### Strong potential in the residential and SOHO markets

In the residential sector, analogue cordless products still outsell DECT equivalents. At the end of 1996 in Western Europe, DECT accounted for 23% of the revenue generated by residential cordless telephones. If Germany still represents 75% of the total market, most other European countries are expected to follow that trend in the coming years. The Small Office/Home Office (SOHO) is another mass market where DECT has strong market potential.

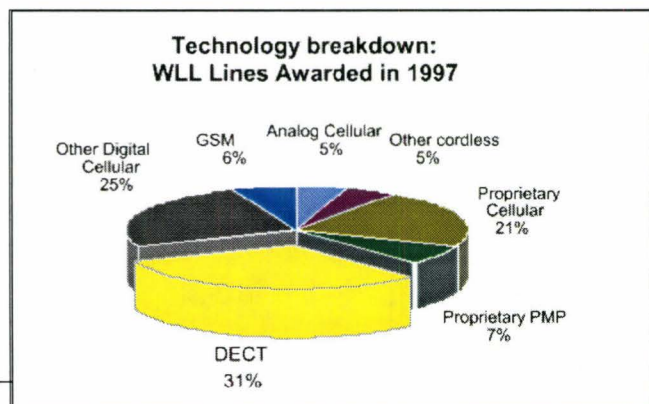
#### DECT in public networks

**Cordless Terminal Mobility** is a key area of interest for the DECT industry. However, in Europe the failure of Telecom Italia commercial launch of such a service, is expected to significantly slow down future development.

**The use of DECT as a Wireless Local Loop** application aroused considerable interest. Many operators have performed DECT WLL trials with satisfactory results. However what could be the actual market potential? An average of a range of forecasts show that the potential market is enormous.

Within this sector, numerous technologies from a multitude of vendors are competing. They range from proprietary systems such as Nortel's proximity, through cordless (DECT) to analogue and digital cellular (GSM, TACS, IS-95), and clearly show that if there is some form of agreement about market potential, there is less agreement about WLL technology.

Most operators wanting to implement WLL solutions are more concerned with the viability of the solution than the actual standard. Until recently, DECT was not seen as a serious contender because of concerns over range and cost. However this is changing and there are indications that DECT is emerging as a leader in global WLL market.





	<b>Opportunities</b>	<b>Constraints / Threats</b>
<b>Western Europe</b>	<ul style="list-style-type: none"> <li>• DECT favoured as European WLL standard.</li> <li>• Strong growth of DECT in the residential and business environment.</li> </ul>	<ul style="list-style-type: none"> <li>• Uncertainties DECT future in CTM (Italian experience).</li> </ul>
<b>Central and Eastern Europe</b>	<ul style="list-style-type: none"> <li>• Largest WLL capacity of developing countries.</li> <li>- Large opportunities in the first adopters of market economy.</li> </ul>	Growing presence of non European technologies (notably CDMA).
<b>North America</b>	<ul style="list-style-type: none"> <li>• Major opportunities may arise once several regulatory issues around local access, arising from the Telecom Reform Act, will be solved.</li> </ul>	<ul style="list-style-type: none"> <li>• No real future for WLL in the USA, as operators strategies are focused on PCS.</li> </ul>
<b>Latin America</b>	<ul style="list-style-type: none"> <li>• One of the fastest growing market for WLL.</li> <li>• Lack of fixed infrastructures.</li> </ul>	<ul style="list-style-type: none"> <li>• Award of local loop licence often depends on local politics.</li> <li>• Spectrum availability remains a key problem (Brazil, Mexico, Peru, Venezuela, Chile).</li> <li>• Strong lobbying from CDMA IS 95 N. American Companies.</li> </ul>
<b>Asia / Pacific</b>	<ul style="list-style-type: none"> <li>• Lack of fixed infrastructures and long waiting lists.</li> <li>• Growing per capita income in several countries. More people can afford a phone.</li> <li>• Rural parts of Australia are poorly served with up-to-date telecoms infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>• Spectrum availability in India.</li> <li>• Too low per capita incomes in India and China.</li> <li>• Strong lobbying from CDMA IS 95 N. American Companies, and from PHS (Thailand and Taiwan).</li> <li>• Perceived high price of Dect for WLL.</li> <li>• Limitation of direct investment.</li> </ul>
<b>Middle East / Africa</b>	<ul style="list-style-type: none"> <li>• Few countries implementing WLL such as Zimbabwe, South Africa, Egypt or Namibia.</li> <li>• Poor or non existing fixed infrastructures.</li> </ul>	<ul style="list-style-type: none"> <li>• Lowest growth rate for WLL and cordless telephony.</li> <li>• Very little activity for WLL in the Middle East.</li> </ul>

## **MAIN REPORT**

## 1. PREFACE

This report presents the findings of a study undertaken by IDATE in association with EGIS on behalf of the European Commission under contract number 48425. Enquiries on this report should be directed to the following:

Role in project	Telephone	E-mail
<b>IDATE:</b>		
François Kornmann	Project Manager	+33 (0)4 67 14 44 20 f.kornmann@idate.fr
Anne Lapasset	Project Partner	+33 (0)4 67 14 44 28 a.lapasset@idate.fr
Frédéric Pujol	Project Partner	+33 (0)4 67 14 44 46 f.pujol@idate.fr
<b>EGIS:</b>		
Eric Lemaire	Project Partner (USA)	+33 (0)1 45 38 70 93 egis@club-internet.fr
Valérie Bichelmeier	Project Partner (Tokyo)	+81 3 32 64 10 60 egis@twics.com

This report is intended to support the European Commission in setting up actions to support EU companies keeping their leading position on the world digital mobile communications markets.

*The views expressed in this report are those of the study team and are not necessarily those of the European Commission or the individuals consulted in this study. All the information has been assembled in good faith and to the best ability of the study team. Neither IDATE-EGIS, nor the European Commission accepts any responsibility for the accuracy or completeness of the information contained in this report. The information and views do not constitute commercial advice or a legal opinion and should not be acted upon without further professional advice. IDATE and EGIS accept no responsibility for loss arising from decisions based on this study.*

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## 2. INTRODUCTION

### 2.1. BACKGROUND OF THE STUDY

At the end of 1997, it was estimated that 63 million of mobile telephony subscribers were connected to a GSM network. Three years from now, out of the estimated 300 million subscribers to mobile telephony services world-wide, 50% should be using GSM technology.

But that leading position is now challenged by other digital technologies and Europe is facing heavy competitive pressure from the USA and Japan in its attempt to make GSM and its next generation system the prominent technology for new cellular networks.

In the cordless arena, DECT is beginning to be more widely adopted, at least in Europe and abroad, after experiencing a slow start. In the wireless local loop arena, DECT could also find market opportunities, especially in developing countries

On the paging side, ERMES, has had a limited success in Europe until now, in the meantime however it has been adopted by a few non-European operators, in the Middle East and Asia.

According to different market forecasts, business opportunities will grow quickly all around the world in the near future, and EU companies must seize most of them to keep their leadership role, but may need to be adequately supported by European bodies to lift potential barriers.

In that respect the DGXIII of the European Commission engaged the IDATE-EGIS consortium to undertake a world-wide study, to analyse the current position of European digital communication technologies, to highlight the constraints that EU companies are currently facing to export their products and know-how, to describe the market potential in the coming years and finally to focus on recommendations of actions to have European companies keeping their leading position on the market.

Terms and conditions of engagement are governed by Contract N° 48425. The study started with contract signature on January 24th 1997.

### 2.2. TERMS OF REFERENCE

#### 2.2.1. Objectives of the study

The major objectives of the study defined by DGXIII were:

- To give a comprehensive overview of the world-wide introduction and deployment of European digital mobile technologies and services;
- To assess further opportunities for their export;
- To describe which restrictions to European firms exist and how these can be lifted;
- And to provide recommendations as to how European industry, and political instances can ensure further development of EU companies on the world markets for digital mobile communications.

### 2.2.2. Scope of the study

The following geographic and technological limitations were agreed at the study kick-off meeting:

#### Geographies:

Europe: EU and EFTA member states:

Five world regions: Asia-Pacific, Africa-Middle East, Eastern Europe, Latin America, and North America. The goal here is not to provide a country by country analysis, but to consider each region as a whole and to make highlight on most representative selected countries.

#### Technologies

Technologies considered are primarily European digital mobile communications ones, which are:

European technology	Application	Major competing technologies
GSM 900 GSM 1800 GSM 1900	Digital cellular telephony	D-AMPS; PDC; CDMA (IS-95); TDMA (IS-136)
ERMES	Digital Paging	FLEX, ReFLEX, InFLEXION
DECT	Residential cordless telephony Enterprise cordless telephony Wireless local loop	Digital cellular (GSM, CDMA ..) PHS, PACS, Proprietary solutions.

Satellite communications are not covered as such by the report, although there may be some references to them in particular cases.

## 2.3. METHODOLOGY

The study will be divided into three major phases of work:

Phase I: Presentation and analysis of the current status of digital communication technologies and players in different world regions.

Phase II: Analysis of market trends in order to detail export opportunities and potential barriers faced by EU companies.

Phase III: Presentation of recommendations of actions to be done to support EU companies keeping their leading position on the market.

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### 2.3.1. Approach

In order to ensure as much consistency as possible across the first two chapters of the study, an analytical framework under three major topics has been defined:

- **Political relation and environment:** highlight of major influence factors such as historical links, geographical proximity or international agreements on the mobile market of a given region,
- **Regulatory and institutional environment:** how did national and/or regional political decisions, in terms of standardisation, market access, frequency allocation or licensing, impacted the evolution of the market.
- **Market Environment:** a better view of the market itself in terms of size and maturity, potential customers (directly linked to GNP/hab ratio), or state of the fixed network infrastructure, is essential to understand why the mobile market of a given region reached a particular level of development.

**Phase I** is mainly based on desk researches by both IDATE and EGIS to consolidate, present and analyse data and information coming from numerous secondary sources: press, annual reports, Internet servers, databases, newsletters etc...

**Phase II** is based both on some existing secondary sources and on about 35 face to face interviews with selected people from most representative organisations:

- Operators and equipment suppliers,
- International organisations: ETSI, GSM MoU, ITU etc.
- Industry organisations: CTIA.

Most of the interviews have been run during international conferences such as GSM World Congress, GSM Asia... Answers have been consolidated and analysed leading to a first level of conclusions. Those conclusions have then been verified and enhanced through a second set of interviews (telephone ones).

**Phase III** is the result of the first two phases that IDATE and EGIS will use to build a list of recommendations.

## 2.4. REPORT STRUCTURE

This report has four main sections following the Strategic report and the Executive summary:

**Introduction** - This section provides an overview of the scope, the objectives and the methodology to be followed during the study.

**Deployment of digital communications in Europe** - This section presents an overview of the European market for mobile communications, from a political, regulatory, market and technical point of view. The section includes both Western and Central and Eastern European countries.

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**Deployment of digital communications in North America, Asia-Pacific, Latin America and Middle-East/Africa.** Following the same structure adopted in section 2, presentation of mobile communication markets in each defined region with a specific focus on European companies and technologies.

**The global market for digital mobile communications: identification of opportunities and constraints .** While section 2 and 3 mainly provide historical facts on a region by region basis, the goal of this section will be to make a global analysis of the mobile communications market, focusing on future trends (both market and technical ones), opportunities, challenges and constraints



### 3. DEPLOYMENT OF DIGITAL COMMUNICATIONS IN EUROPE

#### 3.1. WESTERN EUROPE

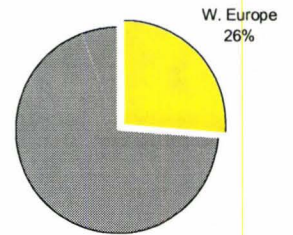
##### 3.1.1. Summary

**Market data**

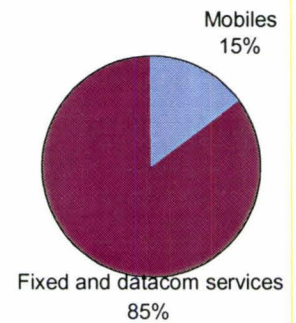
Telecommunication services revenues and subscribers in western Europe

	1986	1991	1996	2001	2006
<b>Market (\$ in billions) :</b>					
Fixed telephony	73.9	103.6	129.8	164.8	192.3
<b>Mobile services</b>	<b>1.3</b>	<b>7.3</b>	<b>29.8</b>	<b>70.0</b>	<b>97.5</b>
Data	5.7	11.7	16.8	22.2	31.9
Others	12.6	16.5	21.4	29.4	33.4
<b>Total</b>	<b>93.5</b>	<b>139.1</b>	<b>197.8</b>	<b>286.5</b>	<b>355.2</b>
<b>Infrastructure :</b>					
Access lines (millions)	136.3	167.9	194.8	229.6	254.2
Fixed teledensity (in %)	37.2	43.3	49.4	57.8	63.7
<b>Cellular subscribers (millions)</b>	<b>0.5</b>	<b>4.4</b>	<b>35.3</b>	<b>125.2</b>	<b>224.1</b>
<b>Cellular teledensity (in %)</b>	<b>0.1</b>	<b>1.1</b>	<b>9.0</b>	<b>31.5</b>	<b>56.2</b>

World Mobile Services Revenues - 1996



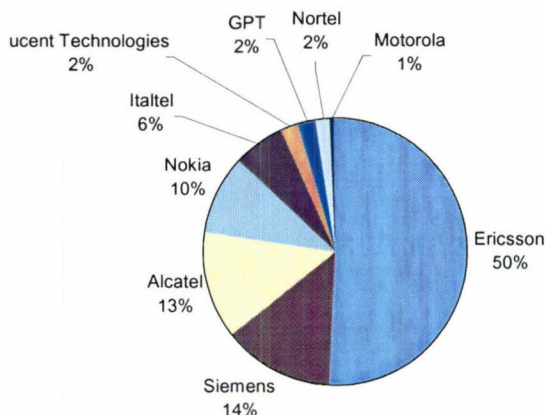
1996 European Revenues



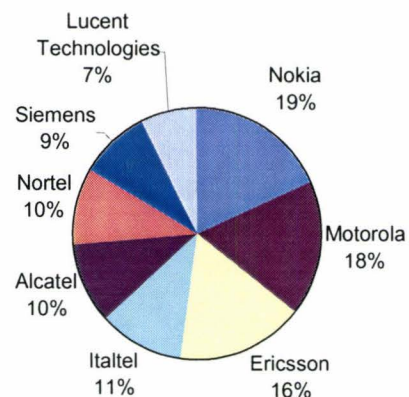
Source IDATE

**Mobile infrastructure equipment manufacturers' presence**

Mobile Switch Suppliers 1997 market shares (based on subscribers number)



Mobile base stations 1997 market shares (based on subscribers number)



**Key facts**

<p><b>Regulatory and institutional environment</b></p>	<ul style="list-style-type: none"> <li>- Progressive markets liberalisation until full competition on 1<sup>st</sup> January 1998 in most countries.</li> <li>- At least <b>two mobile operators in each country</b> (even 3 and more operators in most of them).</li> <li>- <b>Very well defined technological choices</b> in cellular telephony (GSM), more open in paging and wireless local loop.</li> </ul>
<p><b>Market Environment</b></p> <ul style="list-style-type: none"> <li>- Cellular telephony</li>   <li>- Paging</li>   <li>- Cordless and WLL</li> </ul>	<ul style="list-style-type: none"> <li>- Mobile networks operational since 1981</li> <li>- Most dynamic segment in the telecommunications services markets</li> <li>- Cellular subscribers expected equal fixed line ones by 2006</li> <li>- Cellular services = 15% of total telecom services revenues in 1996 and 27% in 2006</li> <li>- 45 million GSM subscribers end of 1997</li> <li>- Italy biggest market</li>   <li>- Small market compared to cellular</li> <li>- 5% of world installed base of subscribers</li> <li>- Recent growth mainly due to Calling Party Pays services on analogue networks</li> <li>- ERMES networks had 1 million subscribers in September 1997</li>   <li>- Growing market for residential cordless products and wireless enterprise telephony systems (PBX).</li> <li>- Uncertain future for CTM type of applications following the Italian experience.</li> </ul>
<p><b>Technologies</b></p> <ul style="list-style-type: none"> <li>- Cellular telephony</li> </ul>	<ul style="list-style-type: none"> <li>- All operators implement GSM 900 or 1800 as digital technology for cellular networks.</li> <li>- Main reason of the GSM success have been:             <ul style="list-style-type: none"> <li>- the GSM MoU, with large and co-ordinated action from all players</li> <li>- GSM has been an open standard right from the start</li> <li>- Strong market demand from end users</li> <li>- Ahead of competing technologies</li> <li>- Robust end to end technical solution</li> <li>- Early licensing</li> <li>- Clear and strong political goal to create a unified market within the European Union.</li> </ul> </li> </ul>



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### **3.1.2. Regulatory and institutional environment**

The telecommunications regulatory process in the European Union (EU) should be seen as part of the wider process of the political and economic integration of Europe embodied in the Treaty of Rome. This process was accelerated through the European Community's internal programme which since the mid-eighties has provided a firm basis for European Telecommunications development up to 1992. This role has now been taken over by the broader political framework of the Maastricht Treaty, the Treaty on European Union which entered into force in November 1993.

The European telecommunications sector has historically been characterised by a strong public service monopoly tradition together with an industrial policy of creating « national champions ». This environment has created a strong national orientation for the sector.

Within this context, a first phase of European Union policy was initiated in 1984 with the aim to move the sector forward to establish common development lines:

- standards development
- common research (RACE -R&D in Advanced Communications technologies in Europe-programme between 1987 and 1995, ACTS -Advanced Communications Technology and Services- programme since 1994)
- special development programmes for the least developed regions (STAR and Telematics programmes respectively in 1986 and 1992)

A second phase of European Union policy was initiated in 1987 with the publication by the Commission of the Green Paper on the development of the common market for telecommunications services and equipment. In this Paper, the Commission proposed the introduction of more competition in the telecommunications market combined with a higher degree of harmonisation. The Green Paper proposals received a broad general support from the market actors (operators, users, manufacturers, service providers). On the basis of this favourable reaction, the Commission prepared a programme of actions, including notably

- rapid full opening of the terminal equipment market to competition
- progressive opening of telecommunications markets to competition
- clear separation of regulatory and operational activities in the Member States
- establishment of the European Telecommunications Standards Institute (ETSI) in order to stimulate European standardisation

These actions have subsequently been implemented to a large extent through the adoption of a series of legislative measures in the Member States.

The main steps since the 1987 Green Paper have been:

- the Green Paper on Satellite Communications (1990)
- the Telecommunications Review of 1992
- the Green Paper on Mobile and Personal Communications (1994)
- the Green Paper on Infrastructure Liberalisation (1994, 1995)
- the Communication on Universal Service for telecommunications in the perspective of a fully liberalised environment (1996)
- Green paper numbering (1996)

- Interconnection directive (1997)

Although differences still exist from one country to another regarding the interpretation and implementation of European directives, such a process has been essential to create an homogeneous and open market, allowing the presence of numerous foreign companies (mainly north American and Japanese ones) as equipment suppliers or through equity acquisitions.

#### Presence of non European companies into European cellular operators' capital.



According to three of the major Japanese equipment manufacturers, the European market is an easy market compared with North America and Asia:

" With the advent of GSM as the standard for digital cellular all over Europe, the European market has become easier and cheaper for business development than at the time of analogue systems, where each country had its own analogue standard.

Europe is now much easier to handle than the US, where too many systems co-exist, which both puts a lot of uncertainties and increase the cost of product developments. Europe is also much easier to handle than some Asian markets like China, where not only several systems can be found, but also government policy changes constantly, which makes it very difficult to plan development.

By contrast, European market is rather straightforward which makes it easy to develop a marketing strategy. And all is all, one can say that Europe is a fairly open market." **Matsushita**

" There is no particular difficulties for a Japanese manufacturer, or more generally for a foreign manufacturer to market mobile terminals in Europe. Motorola is an example of foreign company with a strong position on the European market. And Japanese brands usually benefit from a good image among European consumers.

There are no barriers, especially when manufacturing is done in Europe, which is the case for Mitsubishi Electric. The only handicap for Japanese companies is that there is no GSM on their domestic market, which results in later product release compared with other manufacturers. But one can say that the European market for mobile systems is open.

By comparison, Asian markets are usually much closer. Among these, China is a special case, as it also has its own way of thinking. Mitsubishi Electric has therefore so far very limited manufacturing facilities over there". **Mitsubishi**

" The general perception is that Europe is an open market for which business is no problem, and the feeling from Japan is that there is no major restriction. It seems especially open compared with some other markets like China where foreign companies do face restrictions (although for understanding what type of restriction, one would have to talk with the people that are actually doing the job over there).

This perception of openness is indeed supported by the fact that GSM, which is dominating the European market has open specifications". **NEC**

### 3.1.3. Market environment

#### Cellular telephony services.

##### The market

Mobile communication networks for radiotelephony started to be operational in Western Europe as early as 1981 in Sweden, rapidly followed by other Nordic countries such as Finland, Denmark and Norway. First networks were all based on analogue technology until 1992 when digital GSM ones commercially opened in several countries.

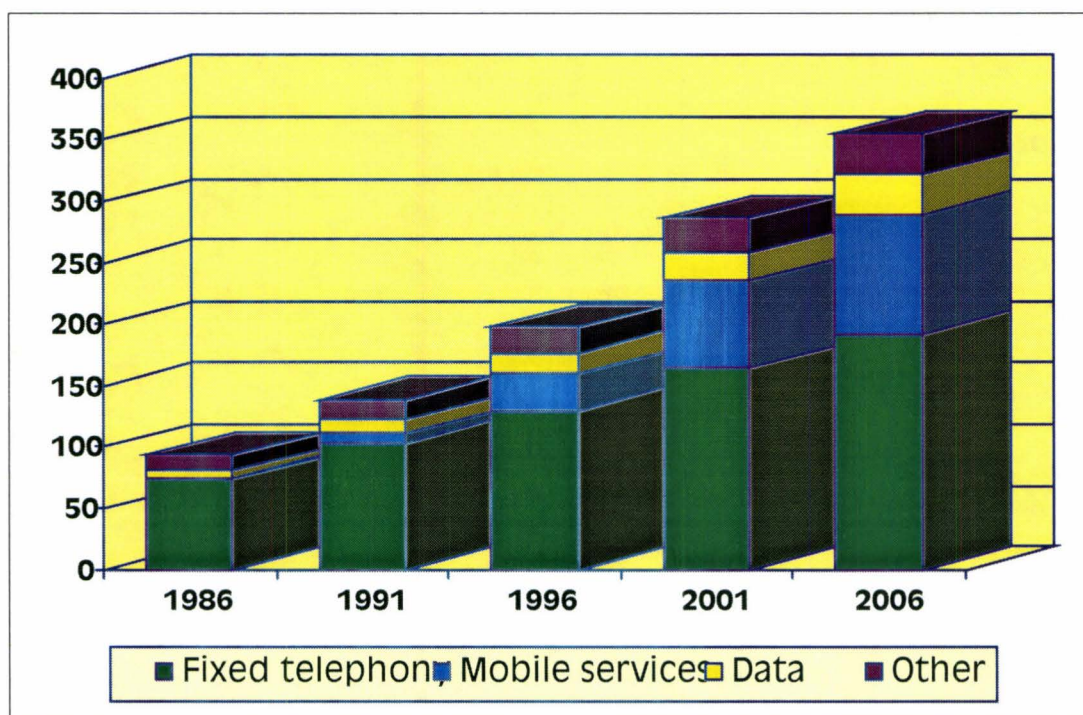
The mobile segment is now the most dynamic in the telecommunications market. Between 1990 and 1996 its share of the total European telecommunication services market went from 3 to 15%, and is expected to reach 27% in 2005.

##### Telecommunication services in value, by sector in Western Europe

	1986	1991	1996	2001	2006
<b>Market (\$ in billions) :</b>					
<i>Fixed telephony</i>	73.9	103.6	129.8	164.8	192.3
<b>Mobile services</b>	<b>1.3</b>	<b>7.3</b>	<b>29.8</b>	<b>70.0</b>	<b>97.5</b>
<i>Data</i>	5.7	11.7	16.8	22.2	31.9
<i>Others</i>	12.6	16.5	21.4	29.4	33.4
<b>Total</b>	<b>93.5</b>	<b>139.1</b>	<b>197.8</b>	<b>286.5</b>	<b>355.2</b>

Source IDATE 1997



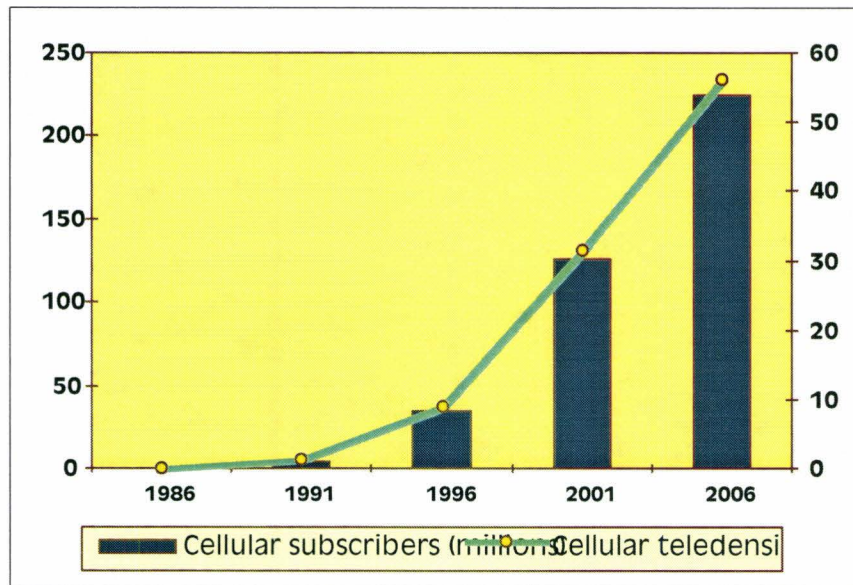
**Evolution of the telecom services market in Western Europe by sector**

In terms of users, eight years from now, the total number of subscribers to mobile telephony services, is expected to be very close to that of the subscribers to fixed line telephony, while it represented 18% of them in 1996.

**Telecommunication service subscribers by sector in Western Europe**

	1986	1991	1996	2001	2006
<b>Infrastructure :</b>					
<i>Access lines (millions)</i>	136.3	167.9	194.8	229.6	254.2
<i>Fixed teledensity (in %)</i>	37.2	43.3	49.4	57.8	63.7
<b>Cellular subscribers (millions)</b>	0.5	4.4	35.3	125.2	224.1
<b>Cellular teledensity (in %)</b>	0.1	1.1	9.0	31.5	56.2

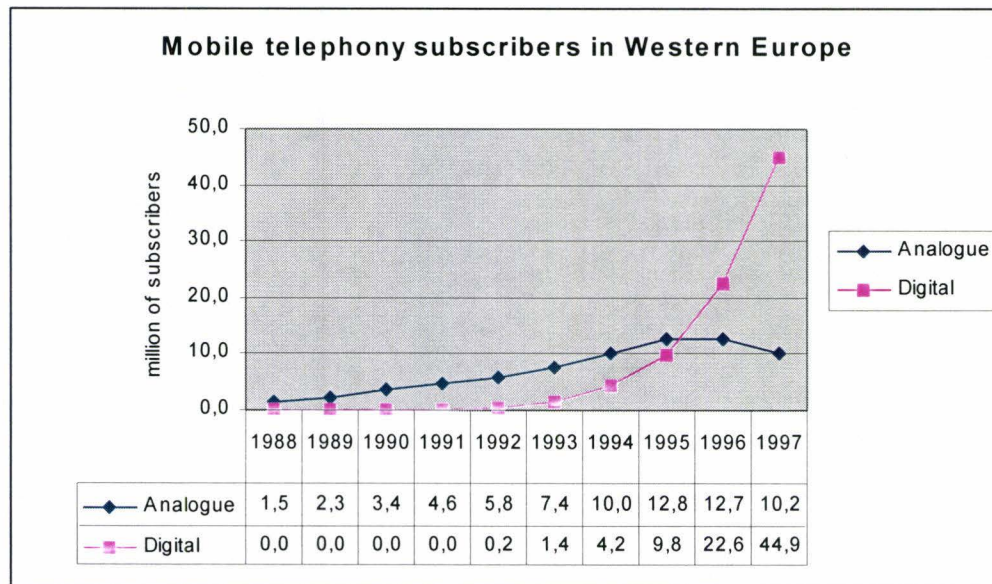
**Western Europe : cellular subscribers and cellular teledensity**



Source IDATE

As of January 1<sup>st</sup> 1998, there were 45 operators in western European countries, operating 76 analogue and GSM networks to which more than 55 million subscribers were connected.

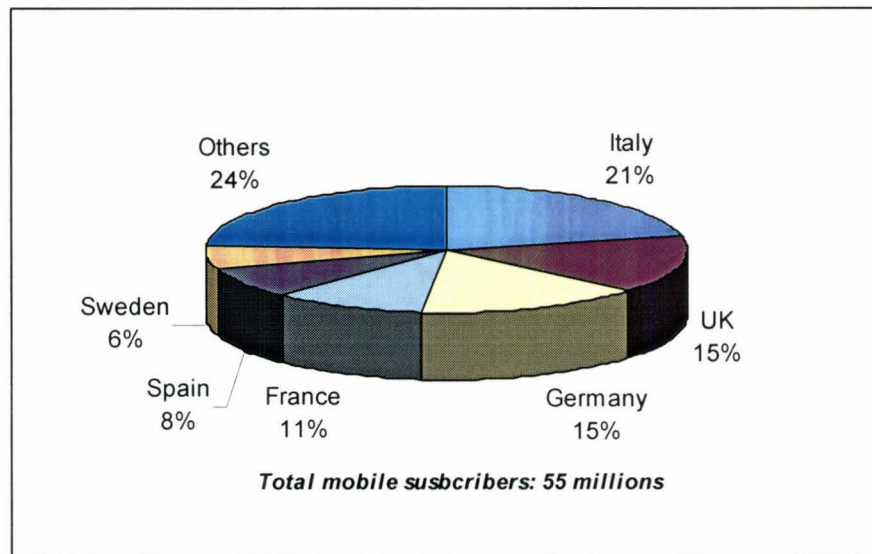
**Cellular subscribers in Western Europe: digital versus analogue.**



Source IDATE and Financial Times

Finally, looking at the geographical split, at the end of 1997, Italy was the biggest country in terms of subscriber number followed by the United Kingdom, Germany and France.



**Cellular subscribers in Western Europe: 1997 country split****The technologies**

All of west European operators implemented GSM (900 or 1800) as digital technology for their cellular networks. Understanding the reasons behind such success is key to anticipate the arrival of new standards.

*The success of the GSM standard*

GSM has been such a genuine success that some might assume that any new digital standard defined by ETSI would be successful. However this is a dangerous assumption to make without understanding the reasons for the success of GSM.

**The first reason to the success of GSM was the original memorandum of understanding (MoU).**

This committed 17 operators to introducing the GSM standard in Europe and thereby immediately guaranteed sufficient volume to make the standard a success. The consequences that followed were:

- several service suppliers invested heavily in the development of network infrastructure;
- many manufacturers put major resources into developing terminals;
- operators outside Europe could be confident that there would be a wide choice of network infrastructure and terminals in volume and therefore at reasonable prices;
- the fact that many large nations were committed to using GSM ensured that any initial bugs in the system would be corrected;
- the MoU was very helpful to new operators and provided an ongoing mechanism for the resolution of technical and commercial problems.

In addition, some features of GSM were particularly attractive, in particular international roaming.

But more importantly was the fact that **GSM has been an open standard right from the start.**

Open interfaces allowed a network to be assembled from infrastructure elements from different suppliers. This ensures that operators are not locked in to one supplier and that prices therefore remain competitive.

However, according to industry leaders, one must keep in mind that **the reasons for the success of GSM are primarily commercial, not technical.** There is nothing wrong with GSM technically, but its success is initially a political triumph not a technical triumph. End users generally do not care whether a system is digital or analogue; they buy on price and performance. This explains why in some countries with well developed standard analogue systems, such as the USA (or Nordic Countries and the UK), analogue continued to outsell digital, for several years. In many countries, however, the analogue systems are poor quality or congested, or digital systems are cheaper than analogue because the digital operators are aggressive newcomers, and so digital outsells analogue.

**The GSM success factors model**

	<b>GSM</b>
<b>Industry support</b>	Large and co-ordinated action through the GSM MoU for operators; broad involvement of equipment manufacturers in the standardisation process, driven by ETSI, to build a common standard.
<b>Market demand</b>	Strong from end users Global pull and support from European operators.
<b>Time to market</b>	In line with market demand and ahead of competing technologies.
<b>Standardisation</b>	As open as possible leading to a real competitive market, and high manufacturer investments.
<b>Technical capabilities</b>	Robust end to end technical solution, with extensive capabilities (international roaming; intelligent networks) and designed to evolve as a backbone for future networks.
<b>Technical constraints</b>	<b>LIMITED IN TERMS OF NETWORK CAPACITY AT THE RADIO INTERFACE LEVEL.</b>
<b>Licensing</b>	Early, on a wide geographical scale to open large potential market. At least 2 licences had to be awarded to stimulate competition in each country.
<b>Political support</b>	Clear and strong political goal to create a common standard and a unified market, at least within the European Union.

**Dark Grey** = disadvantage

Light Grey = advantage

The success of GSM in Western Europe is the result of a good combination of all the above mentioned factors, but none of them taken individually. Most industry leaders agreed on such an explanation, and all of them added that nobody could imagine, up-front, that things would go so well, and that such a combination has been quite fortunate.



**Paging**

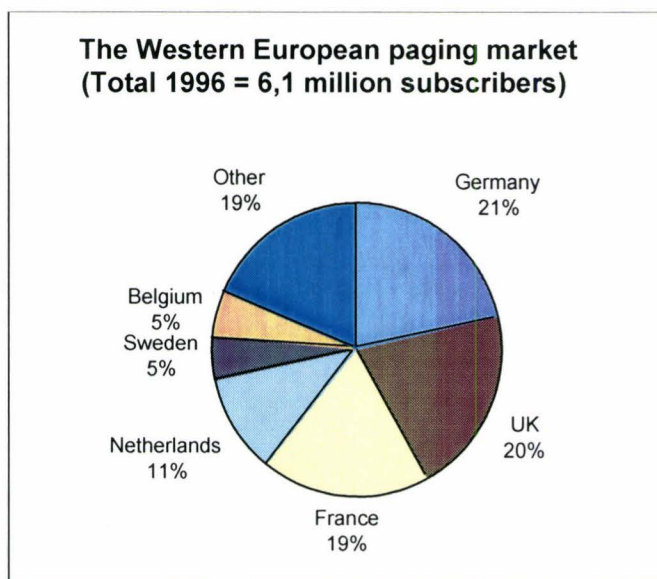
Paging is a smaller market than mobile telephony and is growing much more slowly in western Europe. At the end of 1996, Europe, with an estimated 6.1 million subscribers, accounted for only 5 % of all paging subscribers in the world whereas this proportion rises to 27 % for cellular. The average penetration rate of just 1,5% of the population can be compared with penetration rates of 15.8% in the USA and 30% in some Asia-Pacific countries such as Hong Kong and Singapore.

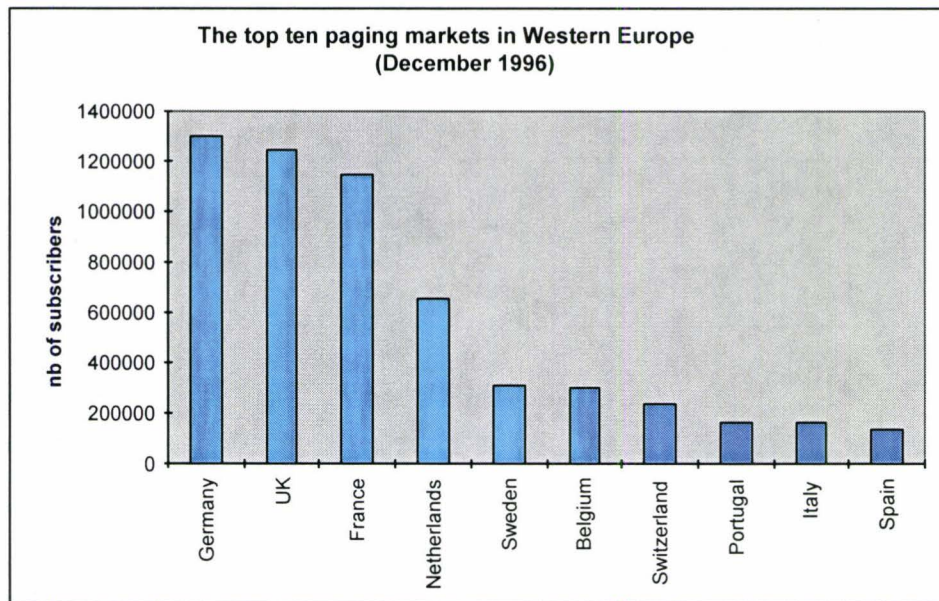
Revenues per subscriber are also considerably lower. Lower revenues are partially offset by lower operating and network construction costs. However, the economics of building stand alone paging networks are being questioned by several industry players. There is evidence of consolidation in the industry with several operators either having, or planing to merge operations. It is possible that consolidation of paging into mobile voice networks will also occur.

The CPP (Calling Party Pays) paging segment is the fastest growing in the paging market. In the UK, CPP paging services are offered by BT, Vodafone and Mercury. Mercury had 100.000 CPP paging subscribers out of a total of 250,000 subscribers in 1996. The launch of Tadoo and Tam-Tam in France has also boosted sales, with a particular success in the teenager market. Most countries in Western Europe have now introduced CPP paging services.

ERMES had only one million users in September 1997 and two countries represented more than 90% of the total: 460,000 in Saudi Arabia and 450,000 in France.

**Paging subscribers in Western Europe**





Paging is the longest established form of mobile communications in Europe. The most common systems are the analogue POCSAG and RDS systems. ERMES (initially European Radio Message System, now renamed Enhanced Radio Message System) was developed as a European digital paging system in the same way that GSM was developed for the cellular telephony market - to provide greater functionality, intelligence and roaming capability. However, the ERMES standard has not been as successful as GSM, and this may be partially explained by several factors:

- the lack of real support from European operators which is not comparable to the support given to the GSM standard during its development phase;
- the attitude of some ERMES licensees (France Télécom for instance) which have not commercially launched a network yet or which do not promote it;
- appeal for ERMES reduced by the existing capacity on the analogue paging networks;
- the cost of implementing ERMES networks seems high both to existing operators and to new entrants for the following reasons:
  - According to Jacques Couvas, Chairman of the EPPA (European Public Paging Association), for existing operators, implementing ERMES would mean to completely scrap installed POCSAG equipment. With FLEX, an operator can simply upgrade its current equipment. Thus financial considerations are quite significant in this matter.
  - ERMES networks do not allow different transmission speeds, and offer only one high-speed service option. For the new operators, installing an ERMES network requires to install up front much more equipment (notably transmitters), representing a higher initial investment. The FLEX system allows to start with a lower configuration (lower transmission speed but much less equipment required), and then move up progressively. In that respect, ERMES does not provide for the flexibility that FLEX affords.

- roaming, which is one of the main advantages of ERMES over analogue systems and Flex, is not yet an attractive feature as major European countries such as Germany or the UK do not have any ERMES network (the first commercial cross-border transmission of paging messages has been demonstrated at the Paging 98 conference in March 1998). Moreover, roaming on ERMES networks outside Europe is not always possible as the designated frequencies for the service have not been harmonised world-wide;

**The ERMES success factors model**

	<b>ERMES</b>
<b>Industry support</b>	Less active MoU organisation. Very few manufacturers developed products. NEC has been the only one for a long time. Now 10 suppliers manufacture pagers and 6 infrastructure.
<b>Time to market</b>	Late in the market already largely dominated by analogue systems, and FLEX outside Europe.
<b>Market demand</b>	Slow growth and small market installed base in Europe (5% of world-wide). Limited investment from EU operators.
<b>Technical capabilities</b>	Enhanced performance and capabilities compared to analogue and Flex systems.
<b>Technical constraints</b>	Less flexibility than FLEX in terms of possible configurations. No two way paging
<b>Licensing</b>	NO HARMONISATION OF FREQUENCIES AT WORLD-WIDE LEVEL.

**Dark Grey** = disadvantage

**Light Grey** = advantage

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### Cordless telephony and wireless local loop

DECT (Digital European Cordless Telecommunications) is a radio access system and can be used in three types of applications:

- as a **cordless mobility system**. DECT represents a significant market in Germany where more than four million residential users have already bought DECT cordless phones. In France, the market is taking-off as the price of the DECT cordless phones has gone under the FF 1,000 threshold. Five million DECT terminals were sold in 1996 all over Europe and it is expected that, according to Dataquest, this figure will reach 15.4 million by 2001. At this date, DECT will be the dominant technology for residential cordless telephones in Europe;
- as a **wireless PBX system**. DECT is ISDN compatible which is a significant advantage in a growing market: wireless PBXs accounted for just 3.7 % of PBX revenues in 1996 but this figure should reach 23.1 % in 2003 according to Frost & Sullivan. On this market segment, DECT is in competition with CT-2 (PHS is not a real contender as it was originally designed as an extension of the PSTN in Japan).
- as a **wireless local loop system**. Public wireless local loop using DECT are in commercial operation or being installed in Spain and Hungary and outside Europe in Bolivia, Myanmar, Cambodia, Indonesia, Singapore and Thailand;  
**Cordless Terminal Mobility**, or CTM, is the other possible application for DECT in public environment. Several trials have been done in Europe, and Telecom Italia went one step further by launching a commercial service based on that technology. Following several months of operation, the services did not take off yet, and many uncertainties about its short term future remain.

One of DECT's problems has been the perceived lack of unity within the industry. Undoubtedly one of GSM's strengths was that the entire European telecom establishment - the EC, governments, regulators, manufacturers and operators - has its collective shoulder behind the GSM wheel, and were heaving in the same direction. No such single-mindedness has been exhibited in the DECT camp. There were early dissensions over whether DECT or an alternative cordless solution, such as CT2, offered the best route forward. Although now resolved, this weakened the drive for DECT at a critical stage. In addition, it could be argued that the DECT standardisation process has been drawn out too long.

The major factors influencing DECT evolution on the market are as follow:

- ◆ **Not cost effective**: It has not been cost effective because the market was not looking for a cordless (e.g. CT2 networks) technology, so there was no mass market, and prices have been too high for a long time.
- ◆ **Strong competition outside Europe**: When GSM was the only total solution available on the market when it started, DECT has been facing a lot of competition, CT2 in Europe, PHS in Japan, PACS in the US.
- ◆ **Different initial focus**: DECT has been mainly developed from private exchanges, and so is not a global system. The development of DECT was based on a bet of a need for a limited mobility.
- ◆ **Slow standardisation**: The standardisation process went slower than expected because of interoperability problems.

- ◆ **Late European vision:** The main disadvantage was that there was the regulatory vision at the European level was unclear.
- ◆ **Time to market and promotion:** From a technical point of view DECT was late on the market and has been supported by a less active Forum.

**The DECT success factors model**

	<b>DECT</b>
<b>Industry support</b>	Lack of unity within the industry. Less active MoU with less actors involved.
<b>Time to market</b>	Late on the market, competition from CT2 systems in Europe, PHS in Japan and PACS in the USA.
<b>Market demand</b>	Starts to take off today (1997) for domestic and enterprise cordless telephony, and in wireless local loop applications.
<b>Standardisation</b>	Standardisation process went slower than expected and some specs have not been developed. The expected move towards TD-CDMA systems, as low mobility systems within the third generation, represent a long term threat to DECT based systems.
<b>Technical capabilities</b>	ISDN COMPATIBLE, WELL DESIGNED FOR WLL AND DIGITAL CORDLESS TELEPHONY.
<b>Technical constraints</b>	Initially not developed as a global system. Based on limited mobility.
<b>Licensing</b>	Regulation regarding licensing has not been finalised yet.

**Dark Grey** = disadvantage  
**Light Grey** = advantage

### **3.1.4. Conclusions**

The liberalisation process of national telecommunications markets together with the harmonisation of standards, allowed to create a strong home European market, which has been a key success factor for EU companies abroad (especially for GSM), without being closed to numerous foreign companies.

Market volume is one of the key factors for the success of mobile telephony standards: GSM clearly took advantage of the good combination of a strong market demand, co-ordination of actions at political and regulatory levels, a wide and homogeneous industry support and a well defined and robust standard.

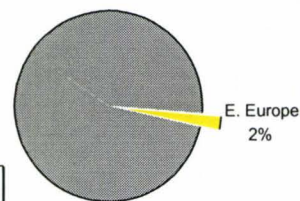
Those success factors have not been fully reused neither for DECT nor for ERMES standards. If DECT experienced a slow start, current market trends and a better co-ordination of industry action, together with enhancement of the standard itself, will mean faster growth, especially in the private arena (home cordless telephones, cordless PABXs), rather than in the public services one.

Regarding paging, the Western European market remained small compared to North America or Asia. This has been a major constraint (among others) for the ERMES standard to properly develop at least in Europe. For the coming year, expected trends of the overall market are good, but should be characterised by strong competitive pressure for ERMES from cellular and PCS systems, as well as the rapid development the US FLEX system.



### 3.2. CENTRAL AND EASTERN EUROPE

World Mobile Services Revenues - 1996



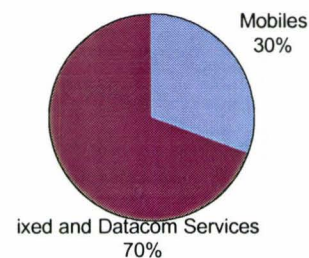
#### 3.2.1. Summary

##### Market data

##### Telecommunication services revenues and subscribers in Eastern and Central Europe

	1986	1991	1996	2001	2006
<b>Market (\$ in billions) :</b>					
Fixed telephony	1.1	2.3	5.2	12.9	20.8
<b>Mobile services</b>	<b>0.0</b>	<b>0.0</b>	<b>2.5</b>	<b>20.8</b>	<b>42.0</b>
Data	0.1	0.2	0.4	0.8	1.3
Others	0.0	0.0	0.1	0.2	0.3
<b>Total</b>	<b>1.3</b>	<b>2.5</b>	<b>8.2</b>	<b>34.7</b>	<b>64.5</b>
<b>Infrastructure :</b>					
Access lines (millions)	36.4	48.4	64.4	88.2	123.9
Fixed teledensity (in %)	10.3	13.3	17.3	23.1	31.8
<b>Cellular subscribers (millions)</b>	<b>0.0</b>	<b>0.0</b>	<b>1.5</b>	<b>24.6</b>	<b>75.1</b>
<b>Cellular teledensity (in %)</b>	<b>0.0</b>	<b>0.0</b>	<b>0.4</b>	<b>6.5</b>	<b>19.3</b>

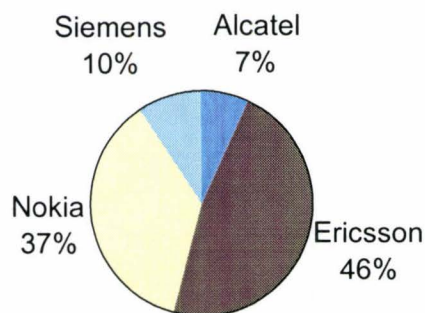
1996 Revenues



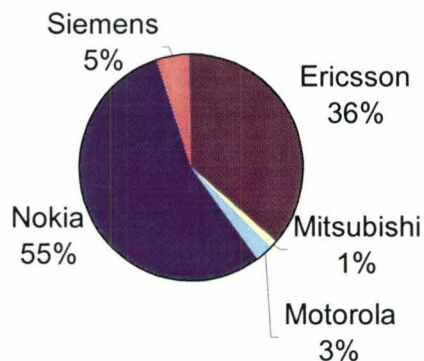
Source IDATE

##### Mobile infrastructure equipment manufacturers' presence

Mobile Switch Suppliers 1997 market shares  
(based on subscribers number)



Mobile base stations 1997 market shares  
(based on subscribers number)





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### **3.2.2. Political relation and environment**

Having broken with the past - with its totalitarian regimes and centrally controlled economies – Eastern Europe and the former Soviet Union are struggling toward democratic societies and market-based economies. Two important objectives for economic modernisation are restructuring of the economic system to a market economy and development of efficient manufacturing. Meeting these goals will require modern telecommunications and full seamless interconnection with Western Europe and the world.

Between 1994 and 1996, 10 countries from central and eastern Europe submitted an application to become EU members,. They are: Bulgaria, Estonia, Hungary, Latvia, Lithuania, Poland, Czech Republic, Romania, Slovenia and Slovakia. The European council defined during the June 1993 meeting, the criteria to be reach by those countries to become members.

- stability of institutions guaranteeing democracy, the rule of law, human rights and respect for and protection of minorities;
- the existence of a functioning market economy, as well as the ability to cope with competitive pressures and market forces within the Union;
- the ability to take on the obligations of membership, including adherence to the aims of political, economic and monetary union.

The "east-west" relationships are then becoming closer than ever, and represent an ideal environment for the European Union, at least for telecommunications, to ensure the creation of a broader home market than the one restricted to the 15 EU members.

### **3.2.3. Regulatory and institutional environment**

Regulation in Central and Eastern European countries has seen its first and main evolution from the nineteen's.

- Separation between regulation and operations was a first step. In January 1990, the Hungarian PTT Ministry established public companies to be in charge of operations. In Poland, the 1990 Telecommunications Law called for the separation of regulatory and operational functions and public companies were created in 1991. In the Czech Republic, the principle of separating regulation and operations was introduced through the 1992 Telecommunications Law.
- The mobile sector was seen as a priority to develop telecommunications networks in Central and Eastern European countries. Several licences were granted in the early 90's to consortia formed with public operators and foreign companies, which brought their expertise in the development of mobile systems and their financial support.

From 1993, partial privatisations were managed over recent years in Central and Eastern European countries : in Hungary, Latvia, Czech Republic, Estonia and Ukraine, the public telecommunications operators were partially privatised and foreign companies selected to acquire stakes.

### 3.2.4. Market environment

#### Cellular telephony services

##### The market

Telecommunications facilities are improving very rapidly in Eastern Europe. In mobile communications in particular, the region is deploying technology at least as advanced as that in Western Europe. If early growth prediction were expecting much higher interest from the market, since two years and the launch of digital cellular networks subscriber growth is now starting to pick-up.

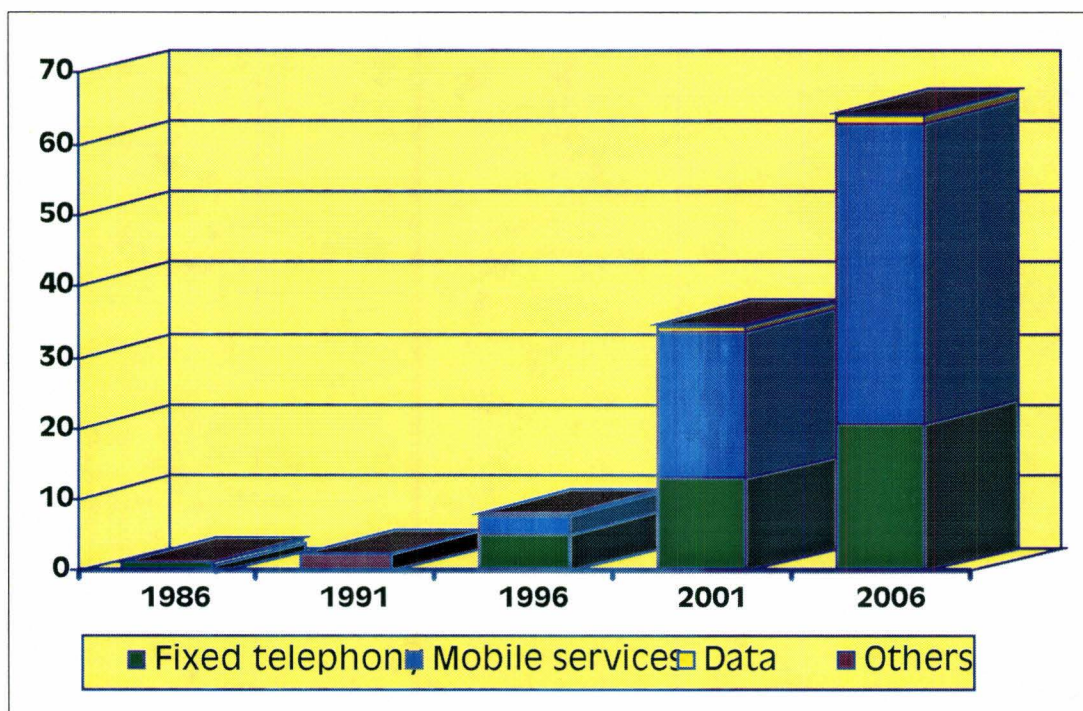
As shown on the following table and chart, mobile services already 30% of total telecom services revenues in that region, and are expected to reach a 65% share eight years from now.

Evolution of the telecom services market in Central and Eastern European countries by sector

	1986	1991	1996	2001	2006
<b>Market (\$ in billions) :</b>					
<i>Fixed telephony</i>	1.1	2.3	5.2	12.9	20.8
<b>Mobile services</b>	<b>0.0</b>	<b>0.0</b>	<b>2.5</b>	<b>20.8</b>	<b>42.0</b>
<i>Data</i>	0.1	0.2	0.4	0.8	1.3
<i>Others</i>	0.0	0.0	0.1	0.2	0.3
<b>Total</b>	<b>1.3</b>	<b>2.5</b>	<b>8.2</b>	<b>34.7</b>	<b>64.5</b>

Source : IDATE

Evolution of the telecom services market in Central and Eastern European countries by sector





The main driving forces behind the development of mobile, as well as fixed, telecommunications in Eastern Europe are twofold:

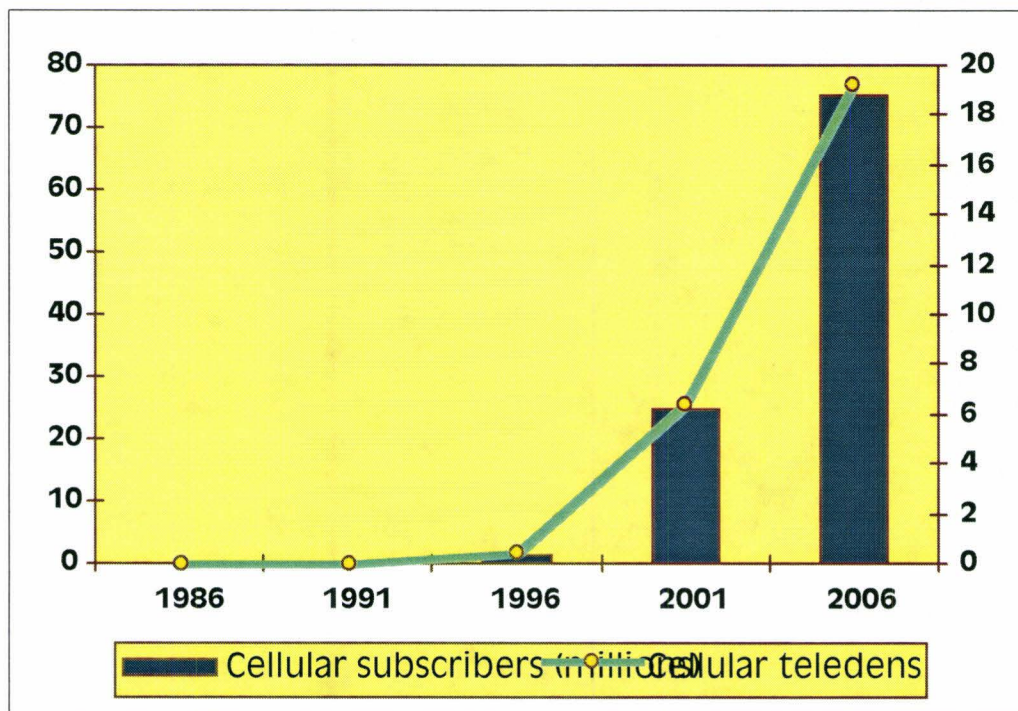
- the urge to catch up with Western Europe after years of under-investment determining the need to set as fast a pace as possible in expanding network coverage and use;
- the urge to join the European Union as soon as feasible, determining that competition must be a significant factor in the new industry structure.

In terms of users, the total number of subscribers to mobile services in Central and Eastern European countries, increased 152% between 1996 and 1997 (from 1.3 to 3.3 million) and is expected to grow at an annual average rate of 48% to reach 75 million in 2006.

	1986	1991	1996	2001	2006
<b>Infrastructure :</b>					
<i>Access lines (millions)</i>	36.4	48.4	64.4	88.2	123.9
<i>Fixed teledensity (in %)</i>	10.3	13.3	17.3	23.1	31.8
<b>Cellular subscribers (millions)</b>	0.0	0.0	1.5	24.6	75.1
<b>Cellular teledensity (in %)</b>	0.0	0.0	0.4	6.5	19.3

Source : IDATE

**Central and Eastern European countries : cellular subscribers and cellular teledensity**

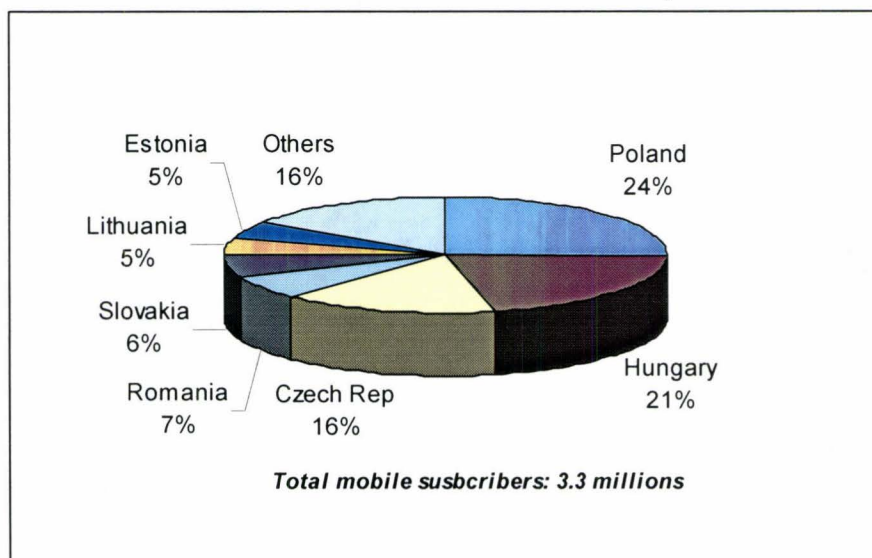


Source IDATE

The eastern European cellular market has passed the two-million subscriber mark in June 1997, 2.2 million compared to 0.8 million subscribers at the same point in 1996, representing an impressive yearly growth

rate of 165%. The acceleration in the growth rate partly reflects the fact that more than 20 new networks were launched in one year.

Looking at the geographical split at the end of 1997, 61% of the 3.3 million users of mobile telephony services were concentrated in three countries, Poland, Hungary and the Czech Republic. Interestingly, Romania now appears on fourth position, thank to the commercial launch of two GSM networks during 1997, which attracted over 200 thousands subscribers at the end of the year.



**Status of the fixed network**

The first market to be liberalised in Central and Eastern European countries was the mobile segment. That explains the growth and the high level of foreign investments. However in many cases, mobile networks are used to compensate for the weakness of the fixed network. According to ITU statistics, at the end of 1995, waiting lists in all east European countries represented about 35% of the actual installed base of main lines, and the average waiting time to get a line was almost 6 years (from 6 months in Croatia, to more than 10 years in Ukraine, Russia or Albania).

Country	Waiting list (in thousands)	Main lines (in thousands)	Waiting list / Main lines	Waiting time (years)
Albania	21	42	50.0%	>10
Belarus	682	1968	34.7%	9.1
Bosnia	Na	238	Na	Na
Bulgaria	607	2563	23.7%	8.2
Croatia	61	1287	4.7%	0.5
Czech Republic	692	2444	28.3%	3.3
Estonia	106	412	25.7%	4.1
Hungary	422	1893	22.3%	2.1
Latvia	110	704	15.6%	6.3
Lithuania	159	941	16.9%	4.4
Poland	2247	5728	39.2%	3.8



Romania	1265	2968	42.6%	9.6
Russia	10525	25019	42.1%	>10
Slovakia	169	1118	15.1%	1.7
Ukraine	3523	8311	42.4%	>10
Yugoslavia	208	2017	10.3%	4.3
<b>Total</b>	<b>20 094</b>	<b>57 653</b>	<b>34.9%</b>	<b>5.7</b>

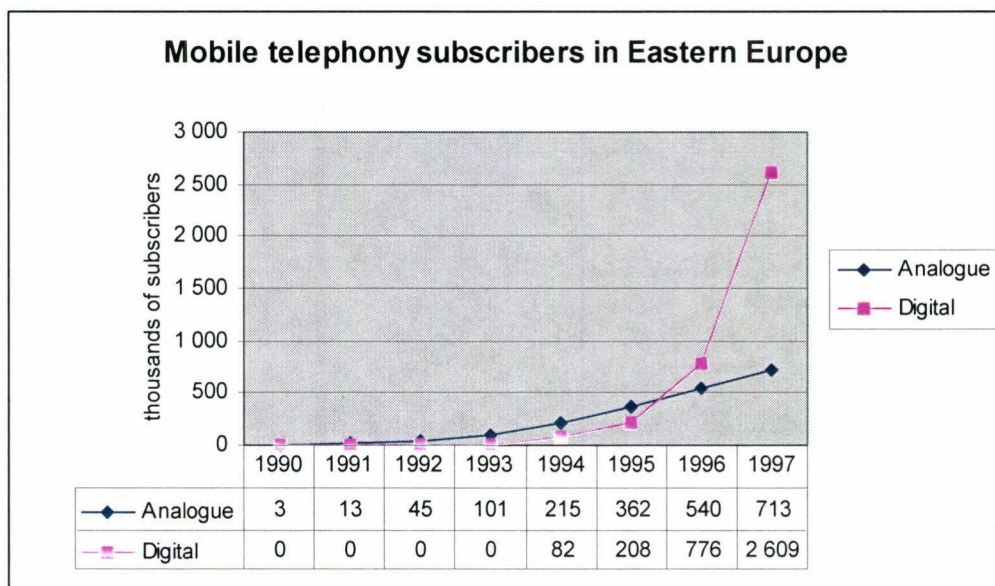
Source ITU World Telecom Development Report 1997/1998

**The technologies**

NMT-450 was the first cellular technology to make a serious impact in Eastern Europe, because it provides good coverage and relatively low-cost infrastructure, and it allows for the use of analogue leased lines to haul traffic around networks.

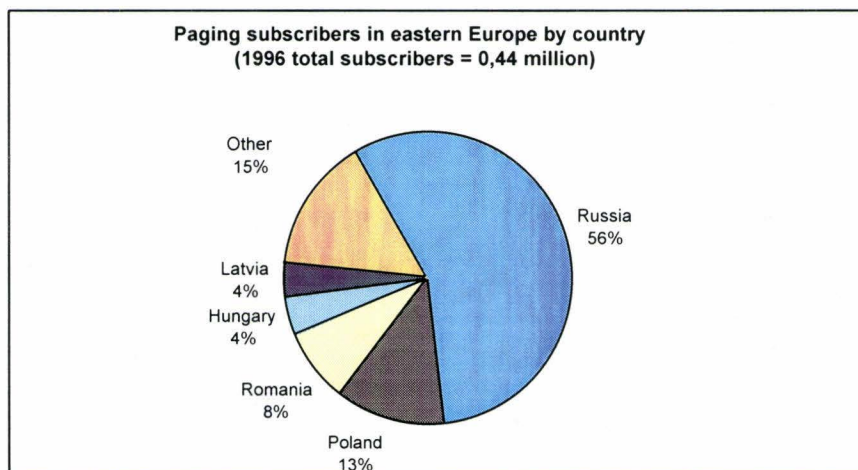
A main focus for NMT-450 operators now is the extension of international and internetwork roaming. But NMT-450 lost the leadership in the year 1996: GSM subscribers represented more than two-third of the market in June 1997. In the first 6 months of the year, GSM networks gained 700000 new subscribers and doubled the installed base while NMT networks gained less than 100000 new subscribers. A main reason for the move towards digital is the concentration of traffic in urban centres.

CDMA is also entering the field, with Motorola and Qualcomm pushing the technology in Russia. To date, however, GSM is the first technology used: in addition to capacity gains, the technology offers lower per subscriber costs for infrastructure, lower prices for terminals, enhanced services and maybe more importantly, international roaming capabilities with all western countries.



**Paging services**

Paging is underdeveloped in Central and Eastern European countries : 443000 subscribers at the end of 1996, which represents a penetration rate of 0.14% compared to 0.44% for cellular networks. Cellular is more considered as a substitutes of deficient fixed networks than paging, which can be considered more as of a kind of value added services. Moreover, the number of public phone box must be important to allow the development of paging services.



**Cordless telephony and wireless local loop**

According to a recent Yankee Group study, Central and Eastern is the region with the most sustained activity to date. It is estimated that the region has 67% of the developing world's Fixed Wireless Access, and that CAGR for the 1996-2001 period is 49%.

Hungary boasts the world's largest WLL implementation so far. Matav has 60,000 subscribers, with a 200,000-subscriber capacity planned for 1998.

Country	Current subscribers	Signed contracts (capacity)
Hungary	82,00	196,250
Czech Republic	30,000	
Russia		117,200

**3.2.5. Conclusions**

Central and Eastern European countries put the modernisation of their telecommunication networks as one of the highest short term priorities to reach western economic standards as soon as possible.

The economic, cultural and geographical proximity with the European Union are all essential for EU companies to keep and strengthen their leading position in that region.

However the evolution is very heterogeneous across that region with countries leading the pack (Hungary, Czech Republic) and others facing hard economic and political times.



## 4. DEPLOYMENT OF DIGITAL COMMUNICATIONS IN NORTH AMERICA, ASIA-PACIFIC, LATIN AMERICA AND MIDDLE-EAST/AFRICA

### 4.1. MOBILE COMMUNICATIONS IN NORTH AMERICA

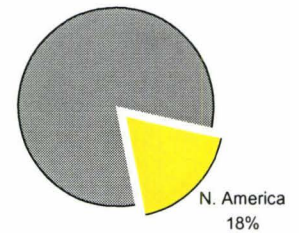
#### 4.1.1. Summary

##### Market data

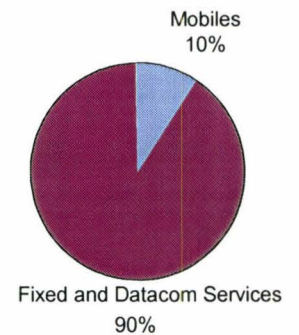
##### Telecommunication services revenues and subscribers in North America

	1986	1991	1996	2001	2006
<b>Market (\$ in billions) :</b>					
Fixed telephony	102.7	121.4	152.8	164.4	175.6
<b>Mobile services</b>	<b>1.3</b>	<b>6.2</b>	<b>20.4</b>	<b>46.6</b>	<b>63.6</b>
Data	15.6	20.8	25.8	33.2	43.1
Others	6.9	10.7	14.4	14.9	15.4
<b>Total</b>	<b>126.5</b>	<b>159.2</b>	<b>213.4</b>	<b>259.1</b>	<b>297.6</b>
<b>Infrastructure :</b>					
Access lines (millions)	134.5	157.0	188.4	203.5	211.9
Fixed teledensity (in %)	50.5	55.9	63.5	67.0	67.3
<b>Cellular subscribers (millions)</b>	<b>0.7</b>	<b>8.4</b>	<b>47.7</b>	<b>96.2</b>	<b>138.4</b>
<b>Cellular teledensity (in %)</b>	<b>0.3</b>	<b>3.0</b>	<b>16.1</b>	<b>31.6</b>	<b>44.0</b>

World Mobile Services Revenues - 1996



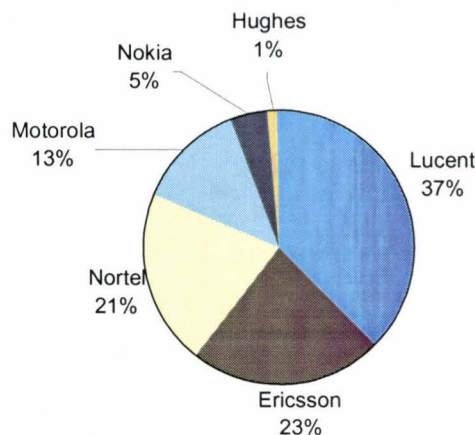
1996 Revenues



Source IDATE

##### Mobile infrastructure equipment manufacturers' presence

##### Mobile infrastructure suppliers 1997 market shares



**Key facts**

<p><b>Political environment</b></p>	<ul style="list-style-type: none"> <li>- Political relations and commercial environment mainly driven by the United States.</li> <li>- Canada is inclined to follow US decisions in terms standards for telecommunications.</li> </ul>
<p><b>Regulatory and institutional environment</b></p>	<ul style="list-style-type: none"> <li>- <b>Widely liberalised market for mobile</b> communications in the USA although regulation for the number and ownership of operators by market area still remains (notably no more than two cellular operators only by area).</li> <li>- Cellular service licences awarded under the <b>'beauty contest'</b> process; PCS ones on <b>auction</b>.</li> <li>- Canadian selection process based on the strengths of individual applications.</li> </ul>
<p><b>Market Environment</b></p> <ul style="list-style-type: none"> <li>- Cellular telephony</li> <li>- Paging</li> <li>- Cordless and WLL</li> </ul>	<ul style="list-style-type: none"> <li>- World largest market in terms of subscribers but third in terms of services revenues.</li> <li>- Most user still connected to analogue networks. The move toward digital technology is recent.</li> <li>- Two main segment: cellular market (800 MHz based services) and PCS market (1900 MHz).</li> <li>- Very concentrated market: top 10 operators account for 80% of the subscriber base.</li> <li>- 42 million users at the end of 1996.</li> <li>- Constant growth since the 1970s</li> <li>- Very large, large and small operators coexist on the market, however constant move toward concentration.</li> <li>- WLL not developed and not expected to significantly grow in the future.</li> <li>- CT2 licences awarded in Canada to four operators, rapidly changed to PCS licences.</li> </ul>
<p><b>Technologies</b></p> <ul style="list-style-type: none"> <li>- Cellular telephony</li> <li>- Paging</li> </ul>	<ul style="list-style-type: none"> <li>- Several standards for digital cellular networks: PCS 1900 (GSM family), IS-95 CDMA, IS-136 TDMA, and other proprietary systems.</li> <li>- Technology difference often uses as a market weapon to keep customers.</li> <li>- Small interest in the next generation of systems.</li> <li>- Competing technologies are: POCSAG, and Motorola's</li> </ul>

<ul style="list-style-type: none"> <li>- Cordless and WLL</li> </ul>	<p>Flex and Reflex systems.</p> <ul style="list-style-type: none"> <li>- North American cordless telephony uses PCS "unlicensed spectrum, around 1700 MHz.</li> <li>- Canada mainly uses CT2 and Ericsson's CT3 technologies for cordless.</li> <li>- US equivalent to PHS is PACS.</li> </ul>
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### **4.1.2. Political relation and environment**

With only two countries, political relations and commercial environment in North America are mainly driven by the United States.

For both historical and geographical reasons, Canada's industrial policy takes into account and follows its giant neighbour, the USA. As Canada needs good interconnections with the USA, it is inclined to use the same standards for telecommunications in general and for mobile ones in particular.

Regulatory and institutional environment

At the end of 1995, frequency spectrums were freed in the 1900 MHz bands, thus creating a new market, called PCS. The FCC (USA) decided to award these new frequencies to the highest bidders through auctions, whereas Industry Canada decided to award them to a selection of operators against a fixed fee.

The advent of digital cellular networks is directly related to this award of licences. Between 1994 and 1996, more than 2000 licences, with coverage going from national to local, have been awarded to 254 operators.

### **4.1.3. Market Environment**

<b>Cellular telephony services</b>
------------------------------------

#### **The market**

The North American market for mobile communications is the world largest one in terms of subscriber number. However, although it is far ahead any other country in terms of size, most of the subscribers are still connected to analogue AMPS networks. The move toward digital technology is relatively recent in that region, following the award of more than 2000 PCS licences between 1994 and 1996.

This market is divided into two major segments:

#### THE CELLULAR MARKET

Covers wireless services in the 800 MHz frequency bands only, whether using analogue or digital technologies. It excludes services in the 1900 MHz frequency bands.

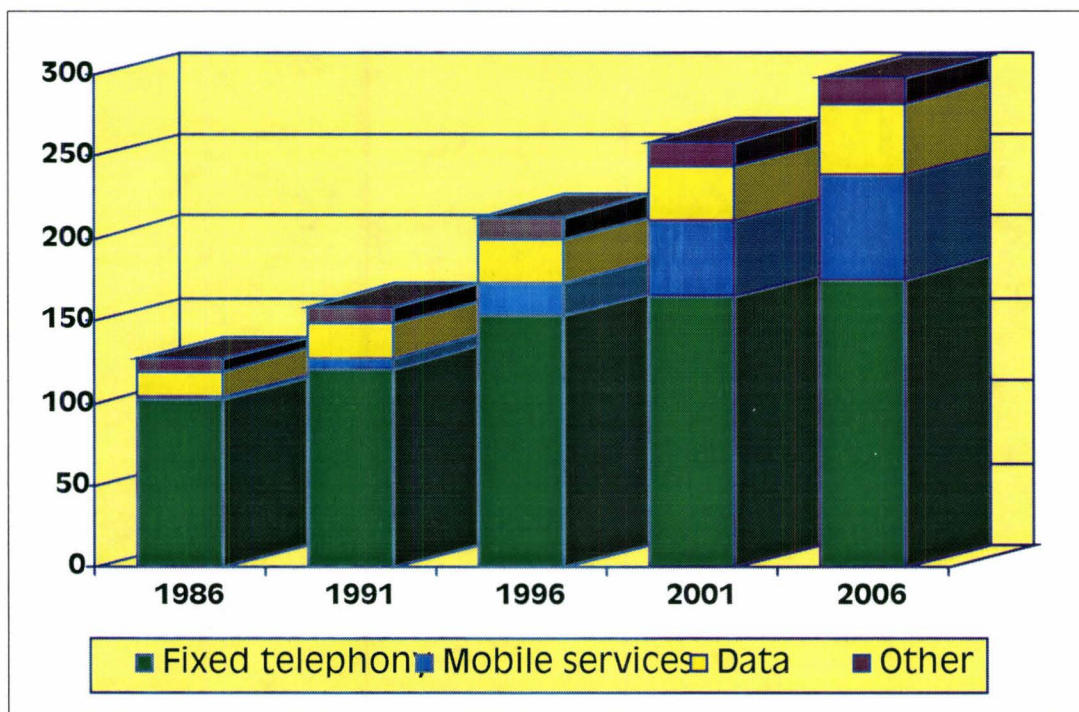
#### THE PCS (PERSONAL COMMUNICATIONS SYSTEMS) MARKET

Covers wireless digital services in the 1900 MHz frequency bands only. It excludes services in the 800-900 MHz frequency bands.

**Evolution of the telecom services market in North America by sector**

	1986	1991	1996	2001	2006
<b>Market (\$ in billions) :</b>					
<i>Fixed telephony</i>	102.7	121.4	152.8	164.4	175.6
<b>Mobile services</b>	<b>1.3</b>	<b>6.2</b>	<b>20.4</b>	<b>46.6</b>	<b>63.6</b>
<i>Data</i>	15.6	20.8	25.8	33.2	43.1
<i>Others</i>	6.9	10.7	14.4	14.9	15.4
<b>Total</b>	<b>126.5</b>	<b>159.2</b>	<b>213.4</b>	<b>259.1</b>	<b>297.6</b>

Source : IDATE



The development of analogue cellular telephony in the United States really dates back to 1984 when services were launched at commercial level. At the end of 1996, the industry represented over 44 million users or a penetration of 15.6% of the US population. Average annual growth over the past five years amounted to 42%.

At the end of 1996, the North American market for telecommunications services was the world's largest one (representing 33% of \$648 billion). However, in terms of mobile communications, with \$20.4 billions of consolidated revenues, North America was on third position after Asia Pacific (\$42.6 billion) and Western Europe (\$29.8 billions), while, it was still the largest market in terms of subscribers for that period. The main driving forces are clearly the fall in the prices of services (the average monthly subscriber bill decreasing from \$97 to \$48 between 1987 and 1996), as a consequence of practically unlimited competition among numerous players.

Although there is a myriad of small local cellular operators, the market remains highly concentrated: the top ten operators in terms of subscribers account for 80% of the total US market. Two major alliances were



made recently: Bell Atlantic with Nynex in 1996 and AirTouch with US West in 1997. In both cases, it is exclusively a question of merging domestic cellular activities.

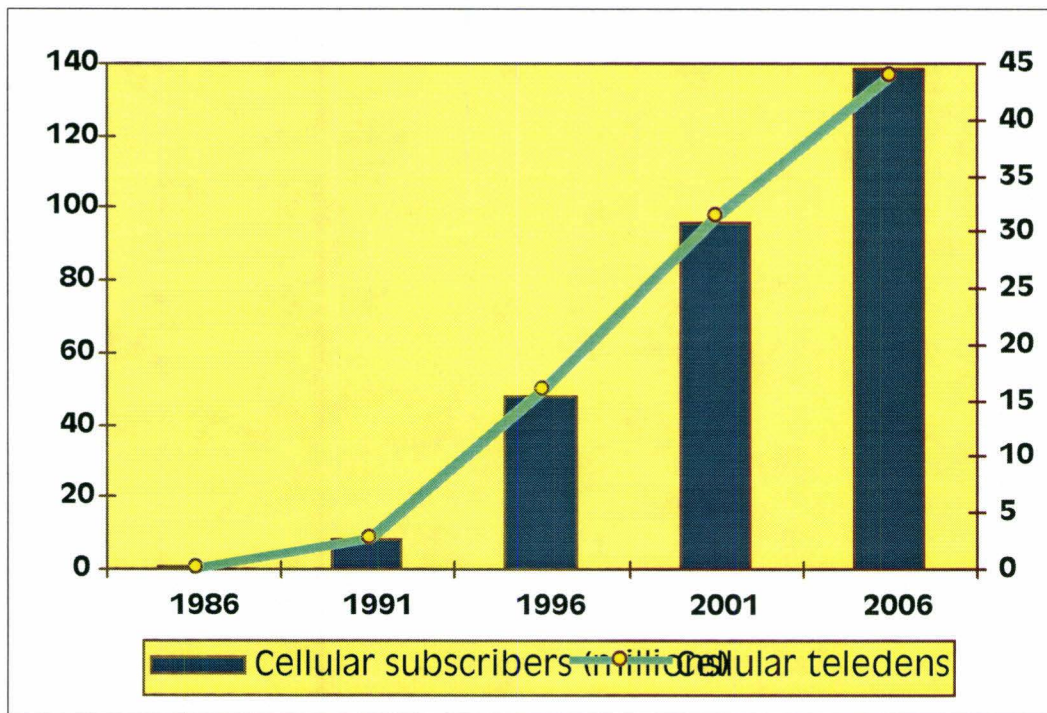
**Telecom services subscribers by sector in North America**

	1986	1991	1996	2001	2006
<b>Infrastructure :</b>					
<i>Access lines (millions)</i>	134.5	157.0	188.4	203.5	211.9
<i>Fixed teledensity (in %)</i>	50.5	55.9	63.5	67.0	67.3
<b>Cellular subscribers (millions)</b>	<b>0.7</b>	<b>8.4</b>	<b>47.7</b>	<b>96.2</b>	<b>138.4</b>
<b>Cellular teledensity (in %)</b>	<b>0.3</b>	<b>3.0</b>	<b>16.1</b>	<b>31.6</b>	<b>44.0</b>

Source : IDATE

The great majority (around 93%) of subscribers are still hooked up to analogue networks, but this figure is due to be reversed with the advent of PCS services and the changeover from analogue to digital standards. By 2005, the majority of subscribers will be connected to digital networks.

**North America : cellular subscribers and cellular teledensity**



Source IDATE

**The technologies**

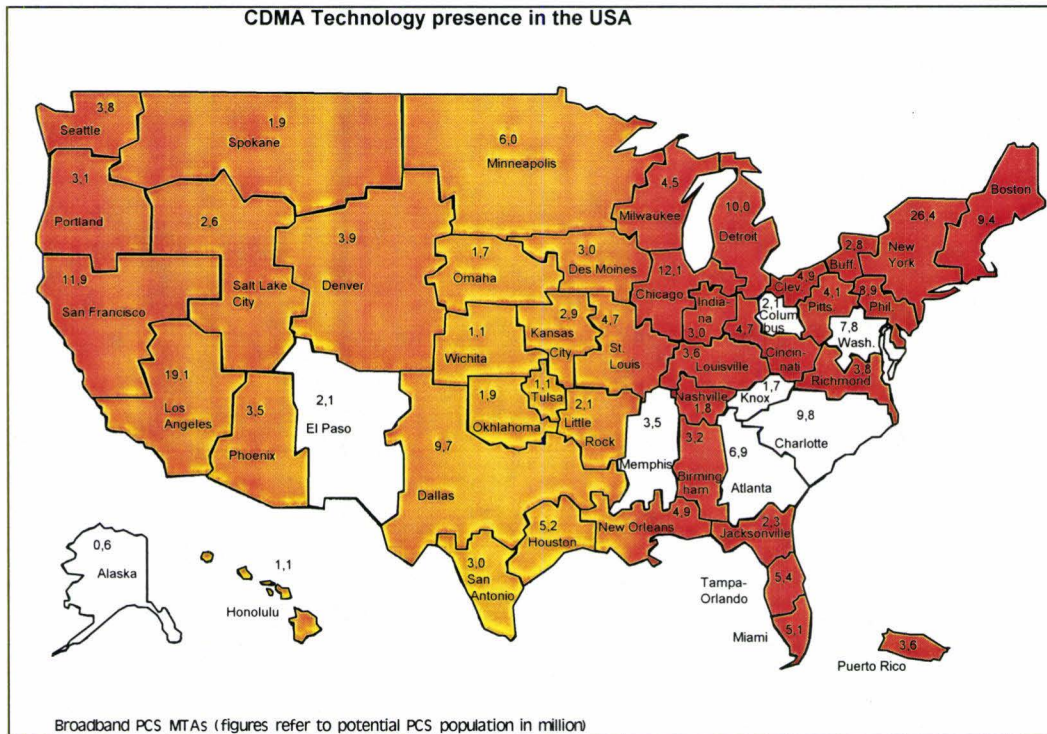
While in Europe the cellular industry was going in the same direction, making GSM a regional and world success, the USA, lost its coherence as Americans failed to agree on a single next generation digital successor to AMPS. While Europe united around a single standard, America, no longer controlled by the old AT&T monopoly, said "let the market decide". In consequence, in the USA there are now several standards for digital cellular networks at 800 MHz: Digital AMPS, CDMA, Narrowband AMPS (NAMPS proprietary to Motorola) and E-TDMA (proprietary to Hughes). Four standards will be used for PCS at 1900 MHz:

- the PCS 1900, an adaptation of GSM to the frequency bands allocated for PCS in the USA;
- IS-95, which uses the CDMA access mode and is backed by Qualcomm Inc.;

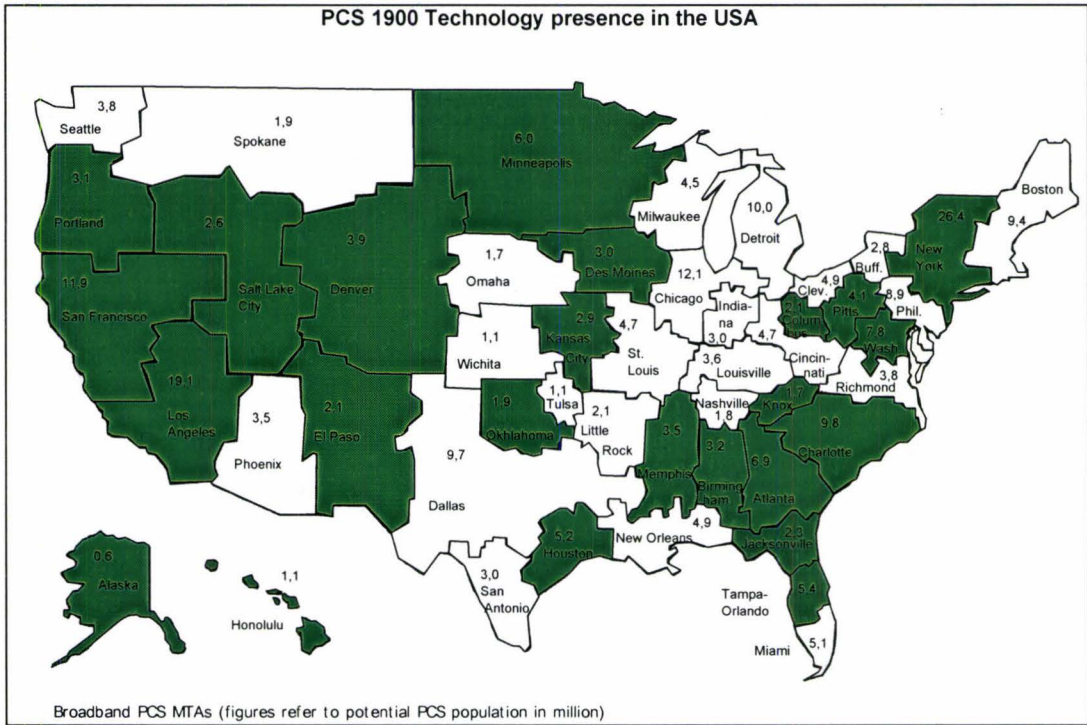
- IS-136, which uses a TDMA access mode but which is totally incompatible with GSM or PCS 1900;
- DS 1900 which is only supported by one operator, Omnipoint.

The US standards, moreover, require the use of dual standard terminals (analogue and digital).

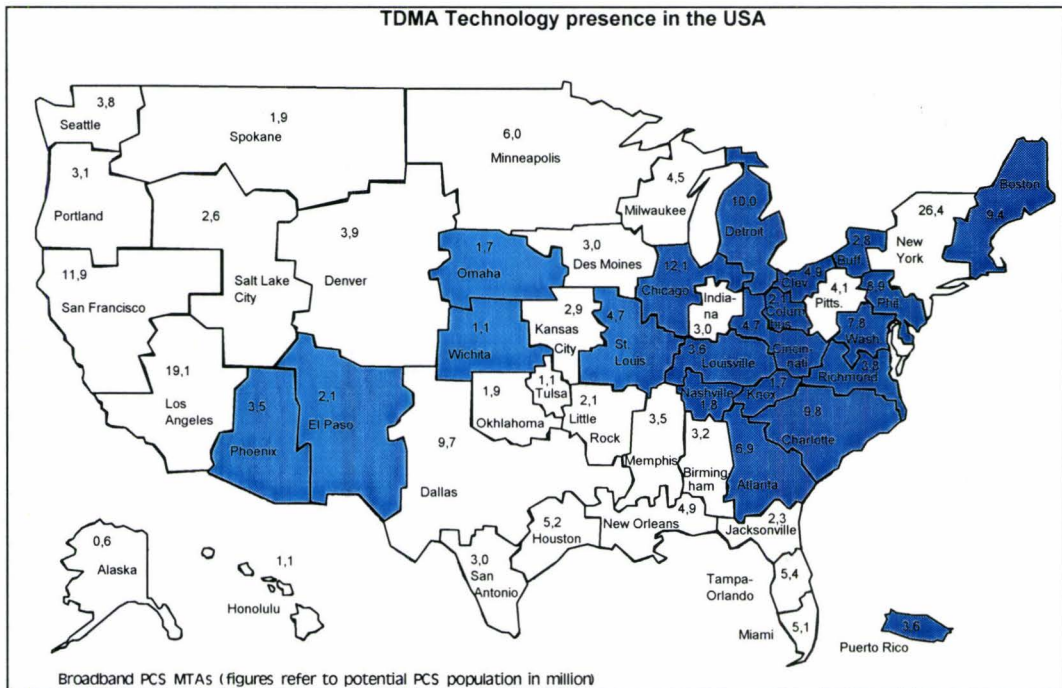
**CDMA:** More than 55% of the US operators that have won a PCS frequency auction have selected CDMA. However, by August 97, only four of them had activated their network with an approximate total of 300,000 subscribers in the USA, and 50,000 in Canada.







**TDMA:** On the cellular market, TDMA was launched in 1994 to convert existing analogue AMPS networks into D-AMPS/TDMA. Today, it has a large installed base and continues to grow more rapidly than CDMA on this market.





**Paging services**

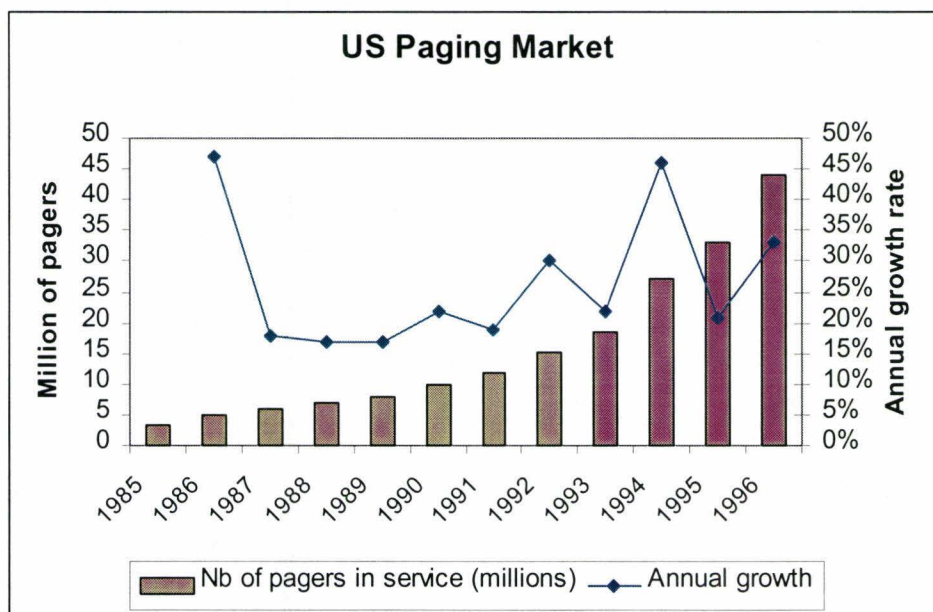
The paging market has enjoyed constant growth since the 1970s, thanks in part to the freeing of new frequencies by the FCC. Since 1990, subscribers have displayed an average annual growth rate of 30%, reaching 42 million at the end of 1996 (against less than 6 million for Europe). By the year 2000, an average annual growth rate of 15 to 20% is to be expected, which will raise the number of subscribers to 60 million. There are around 300 paging operators in the United States, but the top ten account for 50% of the total market. The concentration process has gathered speed recently: in 1995, operators still numbered close on 600.

**Various factors lie behind this growth:**

- the growing mobility of population groups,
- a continuing change towards a service-based economy,
- increased awareness on the part of the general public of the advantages of mobile communications,
- the introduction of new paging services and equipment
- and, lastly, a significant improvement in the price/performance relationship applying to paging services.

At the same time, income generated by the industry has increased more than twofold over a period of 5 years (1993 turnover = \$2.8 billion). As in the cellular sector, this increase in the number of subscribers and the amount of revenue achieved by the operators was made possible by a fall in the price of pagers (digital pagers now dominate sales) and in the price of services, resulting in a decrease in the average monthly subscriber bill from more than \$17 to \$14.

**The US Paging market**



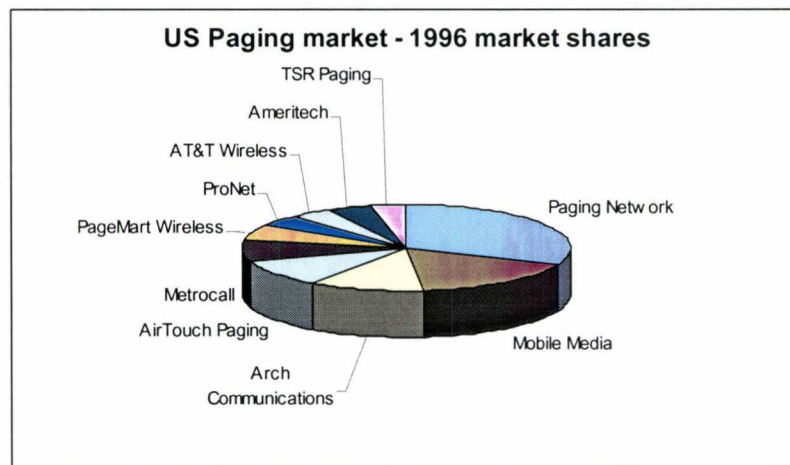
Source IDATE & FT Mobile Communications

Three types of operator can be distinguished:

- the big "generalist" telecommunications operators such as AT&T and the RBOCs, for whom paging is not the principal service,
- independent carriers like PageNet, Mobile Media, Metrocall, etc. who operate paging services in numerous markets,
- and small operators active in a single market.
- This last category is seriously threatened by the growing concentration within the market.

Distribution modes have changed from simple direct selling to various systems such as specialised stores managed by operators, dealers, and representatives of more general distribution chains.

### The top 10 paging operators



Competing technologies are POCSAG, Motorola's Flex and Reflex.

POCSAG was the initial paging technology installed in the US several years ago, and thus holds a very strong position (about 90% of the installed base of subscribers).

The Flex technology is a one-way protocol, and the Reflex the two-way recent version. A third generation will soon be launched, adding voice transmission and called Inflexion.

As opposed to GSM which was launched when no other competing technology was available, ERMES could not have the same success, because POCSAG was already too well implanted on the market. Besides, ERMES operates on 280 MHz, which is not available in the USA, whereas competing FLEX technology operates on 150 MHz.

In addition to that, advanced digital technologies are gradually integrating messaging services within PCS. So, because of this blending of functions, the actual pagers market will go shrinking.

Considering this lack of market growth, and the fact that technologies like POCSAG and FLEX are already well implanted on the pagers market, ERMES without having a strong European "home" market has no real future in North America.



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**Cordless telephony and Wireless local loop**

There is no real future for WLL in the USA. Americans are very mobile and companies like ATT, Sprint, etc. have to pay as much as \$ 25 billion a year to local companies, only to use their local exchange networks (these local telephone companies are still subsidised to cover remote areas). So the trend is to by-pass these local exchange networks through a wide area mobile network and new operators find it easier and faster to focus on the PCS market.

North American cordless telephony uses PCS "unlicensed" spectrum, around 1,700 MHz. In Canada, as on the US market, cordless telephony has not developed like in other countries.

In Canada, CT2+ technology licenses were awarded to four companies: Telezone, Microcell, Mobility Canada and Rogers Cantel. But these networks were never deployed and were changed to PCS licenses (except for Telezone, which disappeared in the meantime and was replaced by Clearnet).

The US equivalent to PHS is PACS (Personal Access Communications System). It is being tested in Atlanta by Bellcore.

DECT is known, but Canada uses CT2+ and Ericsson's CT3 technologies. DECT have not yet made a move in the USA, probably because the system is too expensive: it requires a high number of backhauls (back to the base stations).

So the cordless phone market has very limited practical applications and technologies like DECT have no real future in North America.

#### **4.1.4. Conclusions**

The North American market for mobile communications is open to all technologies, with a high level of installed infrastructure and financial means for further developments. GSM still holds a big advantage over CDMA, because of its enormous critical mass world-wide and its proven good results. However, CDMA should also gradually gain market, thanks to its intrinsic advantages and to a strong US political lobbying.

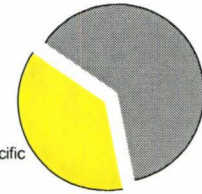
DECT and ERMES are practically non existent in this area and have practically no chance to emerge (lack of market for DECT and high installed competition for ERMES).



## 4.2. MOBILE COMMUNICATIONS IN ASIA PACIFIC

### 4.2.1. Summary

World Mobile revenues - 1996

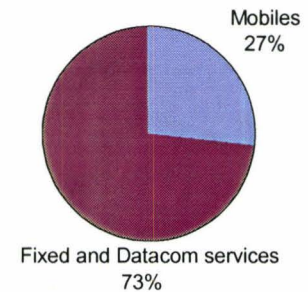


#### Market data

#### Telecommunication services revenues and subscribers in Asia Pacific

	1986	1991	1996	2001	2006
<b>Market (\$ in billions) :</b>					
Fixed telephony	63.9	84.7	94.6	118.8	160.0
<b>Mobile services</b>	<b>1.4</b>	<b>7.0</b>	<b>42.6</b>	<b>69.5</b>	<b>92.7</b>
Data	5.8	8.4	12.2	17.7	22.6
Others	6.4	7.8	9.0	10.5	11.9
<b>Total</b>	<b>77.5</b>	<b>107.9</b>	<b>158.4</b>	<b>216.5</b>	<b>287.2</b>
<b>Infrastructure :</b>					
Access lines (millions)	86.2	122.0	198.9	294.5	428.2
Fixed teledensity (in %)	3.1	4.0	6.0	8.3	11.3
<b>Cellular subscribers (millions)</b>	<b>0.1</b>	<b>3.0</b>	<b>40.6</b>	<b>136.8</b>	<b>220.3</b>
<b>Cellular teledensity (in %)</b>	<b>0.0</b>	<b>0.1</b>	<b>1.2</b>	<b>3.9</b>	<b>5.8</b>

1996 Asia Pacific Revenues

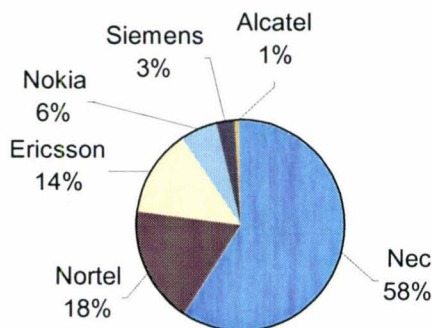


Source IDATE

#### Mobile infrastructure equipment manufacturers' presence

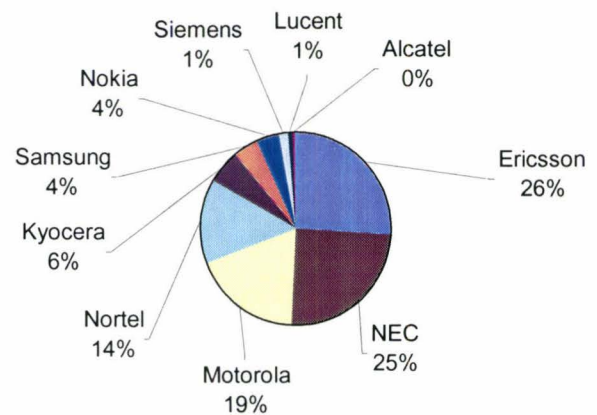
#### Mobile switch suppliers - 1997 market shares

(Based on the number of subscribers)



#### Mobile base stations suppliers - 1997 market shares

(Based on the number of subscribers)





<ul style="list-style-type: none"> <li>- Paging</li>   <li>- Cordless and WLL</li> </ul>	<ul style="list-style-type: none"> <li>- GSM is out of Japan, where digital networks use PDC technology, and CDMA more recently.</li> <li>- CDMA is making inroads in several countries: Korea, Japan, Hong Kong, India, Indonesia, Philippines, Singapore, Thailand.</li> <li>- Japan is pushing hard to move quickly toward third generation systems.</li>   <li>- Most networks use POCSAG.</li> <li>- Flex rapidly became the dominant digital standard (adopted by 39 operators across the region)</li> <li>- One operator adopted ERMES, and has yet to launch its services.</li>   <li>- PHS quickly became the leading cordless technology in Japan and at least seven countries in the region.</li> <li>- DECT presence is mainly in the WLL arena, notably with contract awarded to Siemens and Ericsson in the Philippines and Indonesia.</li> <li>- DECT and PHS have different market positioning: DECT is perceived as a wireless PBX standard, PHS is for public services in high density cities. The two technologies compete on the WLL field.</li> </ul>
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#### **4.2.2. Regulatory and institutional environment**

If, until 1993, there has been only limited deregulation in most of Asia-Pacific region, notably in such countries as the Philippines, Australia, New Zealand and Japan, liberalisation has been accelerating over the past few years, also spreading to such countries as India, Malaysia, Korea, Taiwan, Indonesia, Hong Kong and Singapore.

Generally speaking however, if deregulation has been driven by pressing needs to expand domestic infrastructure for both basic and advanced telecommunication services, as well as pressure from western equipment manufacturers and operators willing to take their share of these high growth telecommunication markets, the current trend seems to favour some more sustained form of competition.

In all Asia-Pacific countries, the mobile communication sector is now open to competition. Further, although exceptions remain, many Asian regulators have adopted a technology neutral approach, in order to foster competition, and therefore allow several systems to coexist. Most of these countries have adopted GSM systems, although in a number of cases, GSM also co-exists with other digital systems like D-AMPS. Noticeable exceptions are Japan and South Korea, where GSM remains absent.

A great variety of regulatory situations can nevertheless be observed throughout the region.

- At the top end of liberalised markets, is **Australia**, that is completely committed to free competition, and removed all restrictions regarding the number of licenses, effective since July 1st, 1997. Australia is scheduling tenders for spectrum allocation.
- At the other end, a country like **China** has only started very recently to deregulate its market by introducing a second operator, and is still working on developing a regulatory structure that will ensure sustained competition. It is also the only country that has maintained a ban on direct foreign investment and operation of telecommunication networks.

Between these two extremes, there are:

- Developed countries like **Japan**, that are clearly moving ahead in deregulating their telecommunication markets, as part as a broader deregulation movement that aims at being a competitive player on the global markets.
- Countries like **Malaysia** and the **Philippines** have realised that too many licenses have been issued, notably for mobile communications, resulting in chaotic situations with near bankruptcy operators, and not necessarily better services for users. In such countries, government are now encouraging consolidation among private sector operators.
- Countries like **Taiwan, Korea, India or Indonesia** have staged some tenders over the past couple of years for mobile licenses, opening the door to full competition.
- Countries like **Singapore** are among the late comers in deregulation, with Singapore Telecom's monopoly that only expired on April 1, 1997.
- Countries like **India** have set up brand new regulatory environment, including regulatory body, that have yet to prove if they can function as independent and impartial arbiter.

### 4.2.3. Market environment

**Cellular telephony services**

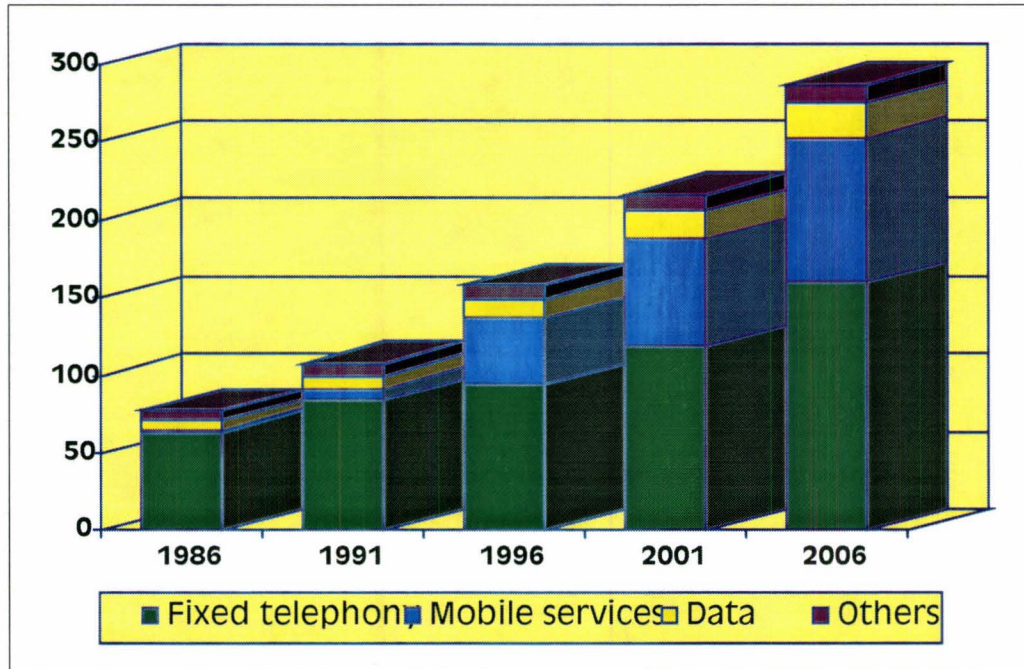
**The market**

With consolidated revenues of \$42.6 billion for mobile services, Asia-Pacific was world's largest market at the end of 1996, However 75% of that total came from one country, Japan. Looking ahead, the region is expected to grow at an annual average rate of 8% over the next ten years, and Japan's share should be down to 56% at that time.

**Evolution of the telecom services market in Asia-Pacific by sector**

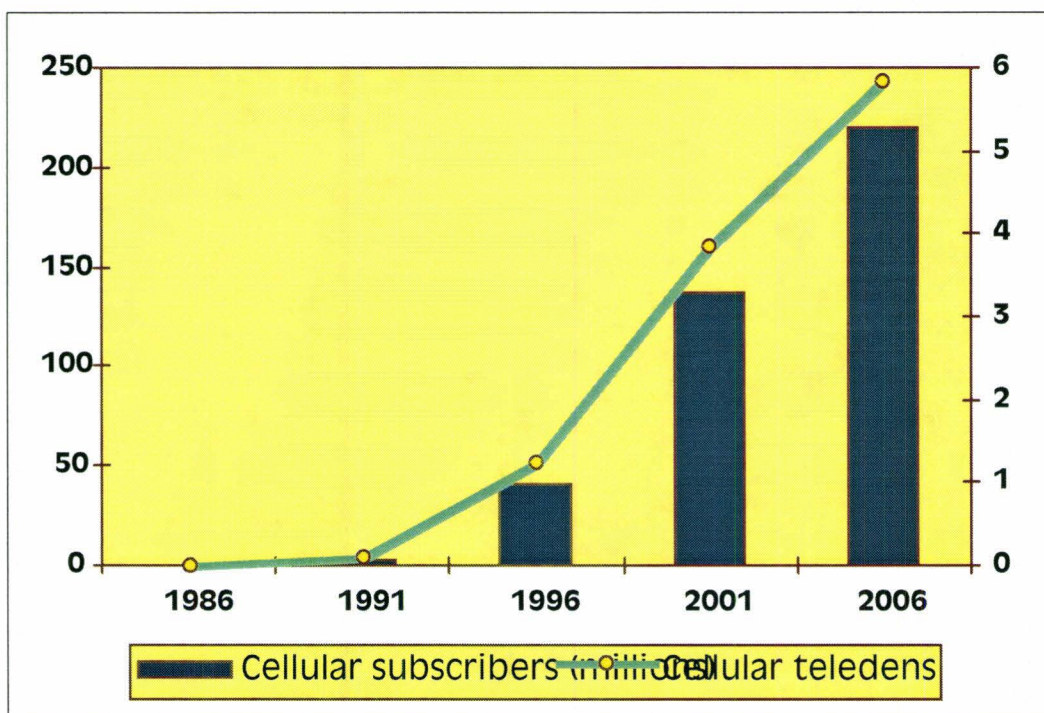
	1986	1991	1996	2001	2006
<b>Market (\$ in billions) :</b>					
<i>Fixed telephony</i>	63.9	84.7	94.6	118.8	160.0
<b>Mobile services</b>	<b>1.4</b>	<b>7.0</b>	<b>42.6</b>	<b>69.5</b>	<b>92.7</b>
<i>Data</i>	5.8	8.4	12.2	17.7	22.6
<i>Others</i>	6.4	7.8	9.0	10.5	11.9
<b>Total</b>	<b>77.5</b>	<b>107.9</b>	<b>158.4</b>	<b>216.5</b>	<b>287.2</b>

Source : IDATE



**Evolution of the telecom services infrastructure in Asia-Pacific**

	1986	1991	1996	2001	2006
<b>Infrastructure :</b>					
<i>Access lines (millions)</i>	86.2	122.0	198.9	294.5	428.2
<i>Fixed teledensity (in %)</i>	3.1	4.0	6.0	8.3	11.3
<b>Cellular subscribers (millions)</b>	0.1	3.0	40.6	136.8	220.3
<b>Cellular teledensity (in %)</b>	0.0	0.1	1.2	3.9	5.8



With 68 million cellular phone subscribers as of the end of 1997, the Asia Pacific Region represents 34% of the world's market, and is the fastest growing region for cellular phone services. As of January 1998, 16 million of these users were GSM subscribers; the Asia-Pacific region now represents about 25% of the world's GSM subscriber base, from just 1% in 1993. Further, the region is expected to continue to enjoy the fastest growth in the coming years, with 50-75 million subscribers forecast for the year 2000, out of the 150 million subscribers expected world-wide. In other words GSM subscribers in Asia-Pacific could represent as much as 50% of the world's GSM subscribers by 2000.

In many countries of Asia, the explosive growth of cellular services is overtaking the expansion of fixed line telephone services. In 1996, the number of mobile phone subscribers soared by 84%, while the number of PSTN subscribers only increased by 14%. And this trend is expected to continue.

At the end of 1995, the number of fixed line subscribers in the 13 major countries of Asia-Pacific amounted to about 170 million for a population of 2.8 billion people, representing an average penetration rate of 6%, a low figure compared with Europe's 48%.



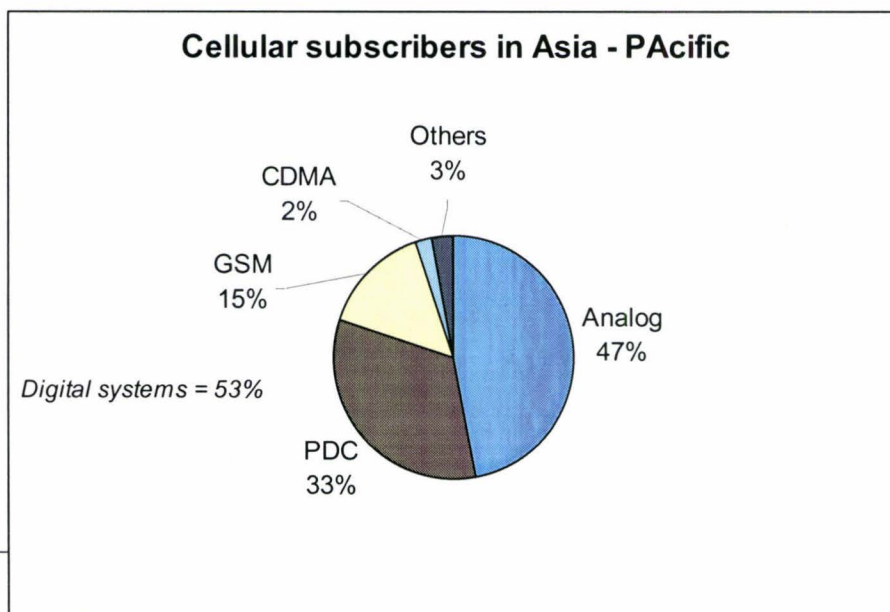
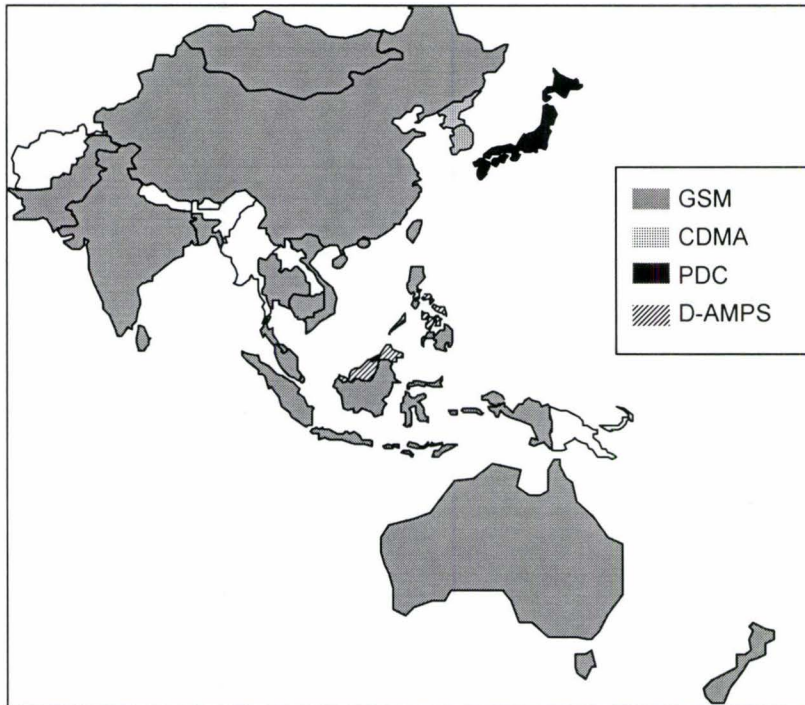
The poor quality of existing fixed network services and the falling profitability of regional telcos, notably in rural areas or on islands, are important factors in the surging demand for mobile phone services in the region. In developing areas, cheaper mobile phone service therefore appeals as an alternate service to fixed network.

**The technologies**

GSM 900 and 1800

GSM has a strong presence in all the Asia-Pacific region (22 countries have running networks), but is completely out of Japan, the region's largest market, whose digital cellular networks are exclusively PDC.

**Digital technologies in Asia-Pacific.**



CDMA

Thanks to intensive lobbying programs driven by US equipment suppliers (Qualcomm, Motorola, Lucent Technologies), several CDMA based networks are now running commercially in a number of countries, while others are in trial or deployment phases.

According to the CDMA Development Group the status of CDMA in Asia is as follow:

Country	Trial	Deployment	Commercial
China	4 networks	1 network	
Hong Kong			1 network (Hutchison Telecom)
India		2 networks	1 network (MTNL)
Indonesia		1 network	
Japan		2 networks (IDO; DDI)	
Korea			5 networks (SK Telecom; Korea Telecom; Hansol PCS; LG Telecom; Shinsegi).
Philippines		1 network	2 networks (Piltel)
Singapore		1 network	
Thailand		1 network	1 network (CAT)

**Paging services**

Asia Pacific countries have been among the most dynamic countries for paging services, with Singapore enjoying the world's highest penetration rate of 32%. Paging has also been enjoying great success in Hong Kong and China. The latter has become the world's second paging market, just behind the US, and is expected to reach the first rank by 2000. Asia also boasts some of the world's fastest growing markets for paging in countries like India.

Great variations in the region

If the paging market has yet to grow in the developing countries of the region, notably China and India, in the most advanced countries, growth is slowing down in front of the growing competition of mobile phone services.

In Japan, paging services have even started to experience the start of a downturn, from a peak of 10.3 subscribers, notably due to the competition from PHS services.

Flex vs. ERMES

Systems in use are overwhelmingly the analogue POGSAG system, as well as Motorola's Flex, which is the dominant digital paging standards and which, as of February 1997, has been adopted by 39 operators in the region, notably Japan, Indonesia, Malaysia and Singapore.

In 1997, China has officially adopted Flex as the country's main standard. Similarly, the Ministry of Information and Communications in South Korea has adopted Motorola's Flex paging protocol as the

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national standard. With 12.3 million subscribers as of the end of 1996, South Korea boasts one of the highest penetration rates of the region at 27%, which is expected to reach 32% in 2001.

So far, only one Asian operator, Celcom Malaysia, has adopted the ERMES standard, although it has yet to launch its services. In February 1997, India also announced it would give equal billing to competing Flex and ERMES. Given the growth potential of India where such services were only launched in 1992 and that only counted 220,000 subscribers as of the end of 1996, this decision is probably the most significant step for the ERMES standard in the Asia Pacific region.

### **Cordless telephony and Wireless local loop**

Launched in Japan in Summer 1995, PHS literally took off in 1996, to reach 6 million subscriptions as of March 1997, a figure higher than the Japanese MPT's most optimistic estimates.

However, less than three year after its launch, PHS based systems and operators are facing very hard times. Market leader, NTT DoCoMo announced a major restructuring of its PHS operations, as that division is expected to post heavy losses (¥67 billion or about \$540 million) for the 1998 fiscal year. Over the last three years, NTT's PHS business recorded accumulated losses of ¥240 (~about \$2 billion).

Initially promoted as a lower cost service, with lighter, smaller and more autonomous terminals than cellular services, PHS is increasingly suffering from a smaller and smaller differential advantage. Cellular have evolved faster than expected both from technological and marketing standpoints (notably high initial deposit and subscription charges have been abolished).

The future of PHS in Japan then looks already very much compromised. NTT is considering merging the PHS business with its cellular phone business in DoCoMo, or liquidating the PHS operations and transferring the assets to DoCoMo. Such a move clearly appear as being the first in an industry-wide restructuring of PHS operations.

#### PHS presence outside Japan

Nevertheless, if Japan failed to export its PDC technology for cellular phone services, supported by Japanese manufacturers eager to finally take their share on the world market of mobile telecommunication equipment, NTT and the MPT are decided to make PHS a recognised standard for personal communication services, starting in the Asia Pacific region.

In the Asia Pacific region, PHS has so far been introduced or adopted in the following countries:

- Thailand, where the first PHS public service outside Japan were to be launched in Bangkok in fall 1997;
- Indonesia, for both WLL and public service (PT Industri Telekomunikasi)
- Singapore for indoor system at the International Convention & Exhibition Center
- Hong Kong, for indoor system (Hong Kong Telecom)
- China (experimental public service, PBX and WLL)
- Vietnam, for public service (Hanoi Post and Telecommunications)
- Australia, for indoor system.



Further, field trials have been conducted in Malaysia, Macao, New Zealand, Fiji and are planned in India for WLL.

Outside the region, PHS has also been adopted in Uruguay, Argentina, Colombia, Guatemala, United Arab Emirates, and South Africa (most of these for WLL), with field trials being conducted in Chile, Mexico, the UK and the Netherlands.

If PHS exports were at less than ¥10 billion in 1996, some estimates indicate that these could reach ¥300 billion by 2000.

So far, DECT's penetration in Asia remains low, and mainly confined to Wireless Local Loop applications. The biggest recent achievements of DECT in the region are:

- a contract awarded by Philippines' Islacom to Siemens in the first half of 1997, that includes 20,000 lines of DECT based Wireless Local Loop;
- a similar contract by Ericsson with Smart Communications also in the Philippines, that was awarded in June 1997;
- an Indonesian contract obtained by Ericsson for 50,000 WLL lines for Pramindo.

In terms of marketing, compared with DECT, PHS has the advantage of an earlier start, as Japan started its promotion even before the system development was completed. PHS can also boast more than 6 million subscribers.

In terms of applications, the European standard is perceived as a PBX-linked standard, where PHS is for public service for shopping and business districts, and is especially suitable for high-density cities where most people are on foot. The PHS MoU Group reckons that the main application where PHS and DECT are really competing is Wireless Local Loop, which constitutes an important market in the Asia Pacific region, and where, so far, none of PHS or DECT has a significant advantage.

Some trials have been made in Hong Kong and Australia to determine whether the 2 systems could co-exist. Interestingly, the Australian study seemed to indicate that if PHS does not affect DECT, DECT can interfere in the operation of PHS when the base station are only few meters away. As a result, recent announcements by the Australian regulator, the Austel, rather favoured PHS over DECT, but so far no final commitment have been made.

If DECT could be seen as benefiting from dual system access with the availability of dual mode DECT / GSM terminals, the recent announcement by NTT supported by Japanese manufacturers like Kyocera to integrate GSM and PHS access on a single terminal might reduce this advantage. Sales of such dual mode terminals on the Asian markets could have a strong influence on the market evolution for personal communication services. Meanwhile the PHS MoU is planning to approach its GSM counterpart to jointly finalise technical specifications of such dual mode system. Success will depend on the hardware characteristics of such terminals (e.g. weight), as well as the type of marketing of dual services (e.g. existence of packaged subscriptions). However, according to Nokia, the technology for dual mode terminals is not yet ready, and could come too late, when the cellular market has completely taken over the PHS market.

#### **4.2.4. Conclusions**

Looking at huge population numbers, growing GDPs, low penetration rates for fixed line services, there is no question about the existence of large market potential in Asia. The question is rather who between European, American and Japanese companies will take the greatest share.

For cellular systems, the future challenge for European companies to defend existing positions or gain new markets in Asia-Pacific will come from Japan, that is in a strong position to market its 3rd generation in the region. Further, so far confined to their domestic market due to the use of a standard that failed to be exported, Japanese makers are eager to, at last, take their share of the global cellular market. In addition to benefit from a technological lead, Japanese makers also have the advantage of increasingly strong economic and political ties.

The current financial crisis can also somehow run against European interests, with Japanese companies traditionally strong at competing on price, and some network deployment probably delayed.

Some European companies like Ericsson and Nokia, that have managed to build some significant positions both in Japan and in the rest of Asia, and that have been invited to join the Japanese 3rd generation project will certainly at least keep and probably further develop their strong positions in Asia-Pacific. The prospect is not so clear for other European companies.

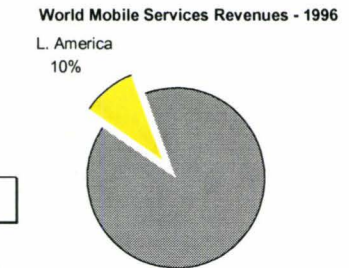
### 4.3. MOBILE COMMUNICATIONS IN LATIN AMERICA

#### 4.3.1. Summary

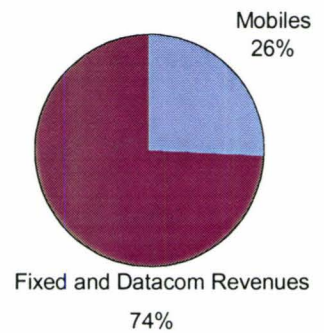
**Market data**

**Telecommunication services revenues and subscribers in Latin America**

	1986	1991	1996	2001	2006
<b>Market (\$ in billions) :</b>					
Fixed telephony	4.3	7.9	27.4	44.1	71.0
<b>Mobile services</b>	<b>0.0</b>	<b>0.5</b>	<b>11.3</b>	<b>43.6</b>	<b>78.0</b>
Data	0.3	0.7	3.2	6.3	10.8
Others	0.2	0.4	2.0	4.1	6.6
<b>Total</b>	<b>4.9</b>	<b>9.5</b>	<b>43.9</b>	<b>98.0</b>	<b>166.4</b>
<b>Infrastructure :</b>					
ACCESS LINES (MILLIONS)	21.5	30.0	47.1	75.1	137.8
Fixed teledensity (in %)	5.2	6.6	9.5	14.0	24.0
<b>Cellular subscribers (millions)</b>	<b>0.0</b>	<b>0.3</b>	<b>6.8</b>	<b>51.6</b>	<b>139.6</b>
<b>Cellular teledensity (in %)</b>	<b>0.0</b>	<b>0.1</b>	<b>1.4</b>	<b>9.6</b>	<b>24.3</b>



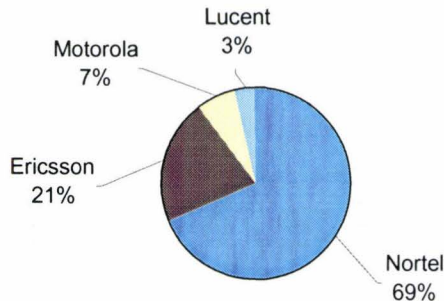
1996 Latin America Revenues



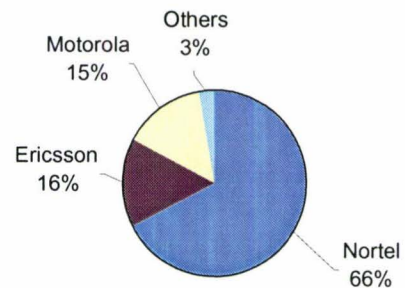
Source IDATE

**Mobile infrastructure equipment manufacturers' presence**

**Mobile switches suppliers - 1997 market shares**  
(Based on the number of subscribers)



**Mobile base stations suppliers - 1997 market shares**  
(Based on the number of subscribers)



**Key facts**

<p><b>Political environment</b></p>	<ul style="list-style-type: none"> <li>- Historical relation with North America formalised into four major international agreements:                             <ul style="list-style-type: none"> <li>- CITELE: 14 members (including USA) with the goal of promoting Inter-American telecommunications.</li> <li>- NAFTA: a general free trade agreement between USA, Canada and Mexico. Several Latin American countries expressed their interest in Nafta.</li> <li>- MERCOSUR: a Latin American agreement with the aim of advancing toward a single market.</li> <li>- Universal Wireless Communications Consortium: an association of carriers and vendors from Americas, to promote product and services based on IS-136 standard.</li> </ul> </li> </ul>
<p><b>Regulatory and institutional environment</b></p>	<ul style="list-style-type: none"> <li>- On going move of all countries toward liberalisation</li> <li>- <b>Implementation of competition or duopoly regime</b> for wireless communications in largest countries.</li> <li>- All Latin American regulators adopted the FCC model of deregulation at the end of the 80s.</li> <li>- <b>Technology neutral approach for PCS</b> licences.</li> </ul>
<p><b>Market Environment</b></p> <ul style="list-style-type: none"> <li>- Cellular telephony</li> <li>- Paging</li> <li>- Cordless and WLL</li> </ul>	<ul style="list-style-type: none"> <li>- World's highest growth rates recorded in recent years (+95% in 1996 and 1997)</li> <li>- Mobile services represent 26% of the region's telecom services revenues.</li> <li>- Mobile expected to become the largest telecom sector by 2006.</li> <li>- Very concentrated: 5 countries account for about 95% of the region.</li> <li>- Brazil and Mexico are the most influent and have the greatest market potential.</li> <li>- Small market</li> <li>- The need to rapidly expand fixed network favours the development of WLL solutions.</li> <li>- Frequencies to be available shortly (following a CITELE decision on September 1997).</li> </ul>
<p><b>Technologies</b></p> <ul style="list-style-type: none"> <li>- Cellular telephony</li> </ul>	<ul style="list-style-type: none"> <li>- Most networks are still analogue and based on AMPS standard.</li> </ul>

<ul style="list-style-type: none"> <li>- Paging</li> <li>- Cordless and WLL</li> </ul>	<ul style="list-style-type: none"> <li>- One Chilean operator adopted the GSM standard</li> <li>- CDMA and IS-136 standard considered as a natural evolution of existing analogue networks toward second generation.</li> <li>- Mainly analogue technologies. Flex starting to make inroads.</li> <li>- DECT gained strength on the WLL market and faces PHS as major competitor.</li> <li>- Numerous proprietary systems coexist for WLL: AirLoop (Lucent); GMH 2000 (Hughes); DIVA2000 (Diva); Multigain (Tadiran); AirSpan (DCS); WiLL (Motorola).</li> </ul>
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#### **4.3.2. Political relation and environment**

Historical links and geographical proximity with North America have been a key factor influencing the evolution of telecommunications in Latin America for a very long time. This has been formalised into four major international agreements.

##### **CITEL**

During the past one hundred years, telecommunications have been an important item in the agendas of the Inter-American states meetings. It was thus that in 1890, during the First International Conference of American States, former designation of the Organisation of American States (OAS), a submarine cable for telegraphic service between the cities of San Francisco in the USA and Valparaiso in Chile was recommended to be laid out.

In 1923, the Inter-American Electrical Communication Commission, considered as predecessor of the current CITEL (Comision Interamericana de Telecomunicaciones) was created in order to initiate the co-operation associated with electricity communications between the American States.

In 1963, the OAS created CITEL, whose main objective was to promote the Inter-American Telecommunication Network.

In 1993, CITEL was reorganised and opened to, as Associate Members, to enterprises, organisms and private telecommunications organisations. Its purpose is to facilitate and promote, by all means available to it, the continuing development of telecommunications in the Americas, along with the existence of appropriate telecommunications for the process of regional development.

CITEL's State Members are: Argentina, Brazil, Canada, Chile, Colombia, Dominica, Ecuador, Honduras, Mexico, USA, Paraguay, Peru, Uruguay and Venezuela.

CITEL's Action Plan for the 1994/1998 period was the following:



- 
- to evaluate the regulatory, technical and legal mechanisms to provide liberalisation, common rules, interoperability of networks and the compatible use of radio frequencies;
  - to examine the means of promoting an increased coherence of the certification processing of telecommunication equipment among the States Members;
  - to develop regional standards to provide services of international networks of aggregated value;
  - to support, realise meetings to promote discussion with reference to the above mentioned decisions.

To give an example of the decisions taken by CITELE, the Sixth meeting of the working group on Radiocommunications, held at the end of 1996, addressed many issues related to fixed wireless access infrastructure. One of the achievements was a recommendation identifying spectrum for fixed wireless access applications in the bands 824-849, 869-894, 1850-1990 MHz and 3,4-3,7 GHz.

Another objective of CITELE is to co-operate with regional and international organisation. For that purpose, an agreement with AHCIELE was signed at the end of 1996. Other agreements with several regional organisations, Comision Tecnica de Telecomunicaciones de Centro America, the Caribbean Telecommunication Union are prepared.

### **NAFTA**

NAFTA came into effect on 1 January 1994 including USA, Canada and Mexico. As a NAFTA signatory, Mexico now provides duty-free access in a number of sectors. Specific provisions under NAFTA are :

- providing a standard of national treatment for foreign investors in other signatory countries
- ensuring secure market access
- improving the dispute settlement mechanism
- opening up government procurement markets to companies located in other member countries
- facilitating cross-border movement of business people
- affording stronger protection to intellectual property rights.

Several South and Central American countries have expressed interest into joining NAFTA. Discussions have gone further with Chile.

### **MERCOSUR**

Slowly but surely, the member nations of MERCOSUR are resolving many complicated issues and are advancing towards a single market. In July 1997, Argentine and Brazilian Minister of Communications met together to start negotiations for the creation of a common communications market. The idea is to have a common framework for services such as data transmission or value-added services.

**Universal Wireless Communications Consortium (UWC)**, an association of carriers and vendors, signed 13 new members since March 1997 from Uruguay, Brazil, Argentina, Ecuador, USA, Chile... The UWC is a corporation established to support carriers and vendors developing, building and deploying products and services based on the TDMA-IS136 and WIN-IS41 standards.

ITU teams up with Inter-American Development Bank to improve telecoms infrastructure in Latin America and Caribbean, with the active support of two regional organisations CITELE and the Caribbean Telecommunications Union (CTU). Main objectives include the set up of strategies on how to mobilise resources and secure financing in the context of a changing regulatory environment for

telecommunications trade and investment, and the study of the feasibility of developing, in conjunction with users, a regional information network.

### 4.3.3. Regulatory and institutional environment

Throughout the region, Latin American governments continue to liberalise the telecommunication sector and create autonomous regulatory bodies. In almost every country that has not already privatised basic telecommunication services, the government is moving forcefully to sell its stake in the PTT.

#### Status of telecommunication regulation in Latin America

Country	Frequency allocation	Standardisation	Market access	Licensing procedure
Argentina	PCS: 40MHz in the 1,8GHz band per operator	AMPS for cellular No technical standard imposed for PCS	duopoly in Buenos Aires since 1993, in the rest of the country since 1995. Full competition in 1998.	Comparative selection
Brazil	PCS: in the 1850-1990 MHz band currently occupied by the Army	AMPS for cellular No technical standard imposed for PCS	Competition in 1998	Auction based on the price offered by the bidder and the future tariffs of the services
Chile		AMPS for cellular No technical standard imposed for PCS	Competition since 1989	Comparative selection
Columbia		TDMA/AMPS required	Competition since 1994	Comparative selection
Mexico	PCS: in the 1850-1990 MHz band	AMPS for cellular No technical standard imposed for PCS	Competition since 1990	Auction
Venezuela		AMPS for cellular	Duopoly since 1991	Comparative selection

### 4.3.4. Market environment

#### Cellular telephony services

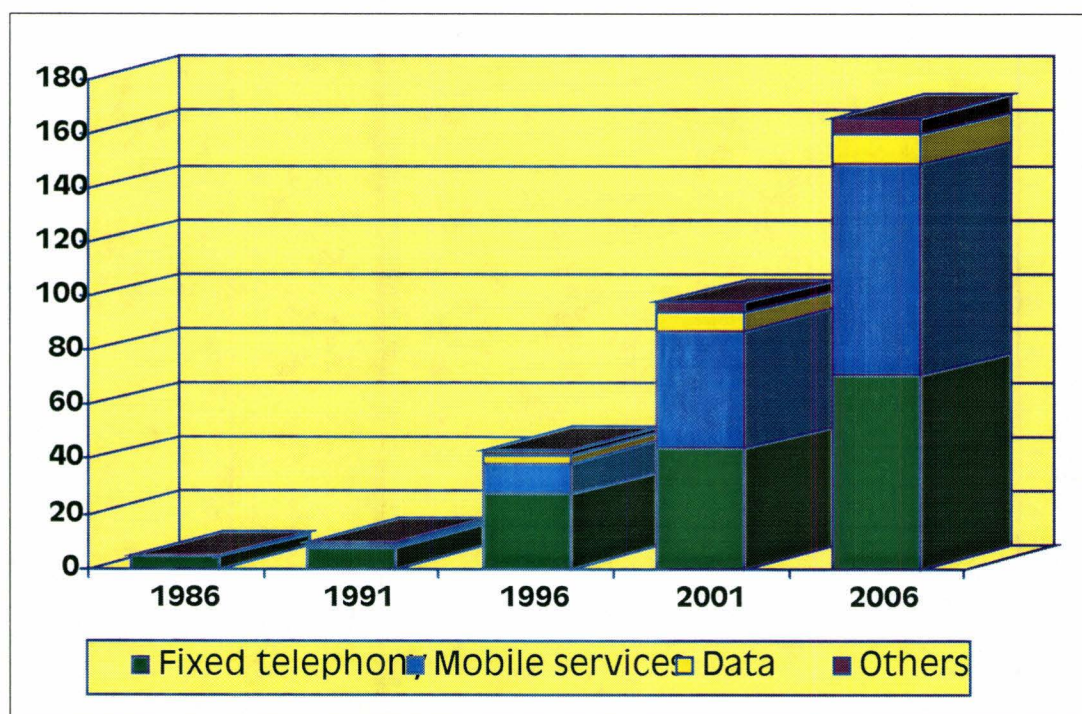
##### The market

Starting from a very low level, Latin America has experienced the world's highest growth rates in recent years: 95% in 1996 and 1997. From a service revenues point of view, with \$11.3 billion, mobile communication represented 26% of the region's total at the end of 1996, and are expected to reach \$78 billion, or 47% of the total, eight years from now. At that time mobile services would be the most important telecommunications sector.

## Evolution of the telecom services market in Latin America by sector

	1986	1991	1996	2001	2006
<b>Market (\$ in billions) :</b>					
<i>Fixed telephony</i>	4.3	7.9	27.4	44.1	71.0
<b>Mobile services</b>	<b>0.0</b>	<b>0.5</b>	<b>11.3</b>	<b>43.6</b>	<b>78.0</b>
<i>Data</i>	0.3	0.7	3.2	6.3	10.8
<i>Others</i>	0.2	0.4	2.0	4.1	6.6
<b>Total</b>	<b>4.9</b>	<b>9.5</b>	<b>43.9</b>	<b>98.0</b>	<b>166.4</b>

Source : IDATE



## Evolution of the telecom services infrastructure in Latin America

	1986	1991	1996	2001	2006
<b>Infrastructure :</b>					
<i>Access lines (millions)</i>	21.5	30.0	47.1	75.1	137.8
<i>Fixed teledensity (in %)</i>	5.2	6.6	9.5	14.0	24.0
<b>Cellular subscribers (millions)</b>	<b>0.0</b>	<b>0.3</b>	<b>6.8</b>	<b>51.6</b>	<b>139.6</b>
<b>Cellular teledensity (in %)</b>	<b>0.0</b>	<b>0.1</b>	<b>1.4</b>	<b>9.6</b>	<b>24.3</b>

Source : IDATE

From the infrastructure point of view, the situation in that region reflects the trends in service revenues. Although very significant effort are done throughout the region to improve the fixed teledensity, cellular subscribers are already growing at a faster rate (over 12 million at the end of 1997), and should pass the number of fixed line by the year 2006.

However, the various markets reveal wide contrasts in terms of equipment and dynamism, according to country:

- Venezuela, Chile and Argentina are currently among the best-equipped countries in the region (they are also the best equipped in terms of fixed lines).
- Mexico and Puerto Rico also boast a good level of equipment, largely because of their proximity to North America.

The market is highly concentrated: five countries account for the bulk of the market (around 95%). Among these, Brazil and Mexico are undoubtedly the countries currently offering the greatest potential, and being the most influent in that region.

#### **Fixed network status.**

The development of mobiles in Latin America is bound up to a large extent with the possibility offered of obtaining rapid, if not immediate, access to a telephone in a region where waiting times for the installation of a fixed line are still relatively long. For operators, too, the implementation of a mobile network is often an interesting alternative for opening up rural areas still deprived of means of telecommunication.

Country	Waiting list (in thousands)	Main lines (in thousands)	Main lines per 100 inhabitant.	Waiting list / Main lines
Brazil	510	12082	7.5%	4.2%
Argentina	111	5532	15.9%	2.0%
Chile	52	1884	13.2%	2.7%
Mexico	197	8801	9.6%	2.2%
Peru	136	1109	4.7%	12.2%
Puerto Rico	57	1196	33.2%	4.7%
Colombia	756	3873	10.0%	19.5%
Bolivia	50	348	4.7%	14.3%
Ecuador	60	748	6.5%	8.0%

*Source: ITU World Telecom Development report 1997/1998*

#### **The technologies**

Most networks are analogue networks based on the AMPS standard. The changeover to digital networks is expected to generate opportunities to GSM, while CDMA and TDMA are, in many cases, considered as a "natural" evolution from AMPS, although in some cases transition is going through the intermediate NAMPS standard (Argentina, Venezuela). As in all other regions, digital systems develop first and foremost in countries already well equipped where problems of frequencies arise. The choice of GSM is uncertain; most countries in the region are awaiting the development of an American standard before taking a final decision: geographical proximity, especially in countries like Mexico, weighs heavily.

A further trend is towards harmonisation of networks in the various countries to facilitate international interconnection and eventually create a vast Pan-American network. One example is provided by Argentina, Chile, Peru and Colombia, which also happened to be countries in which Telefonica is heavily involved.



Personal communication by satellite looks as though it will constitute a real challenge, even if the systems are not yet operational. They should be able to offer better coverage and higher quality than earth networks. The regulatory question remains to be settled, namely obtaining authorisation to operate in the different countries of the region.

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### **Paging services**

Paging services are relatively limited in Latin America despite the presence of numerous operators (up to 80 in Mexico). Two main reasons can explain such a situation:

- Technical: for many years, paging services suffered from technical limitation of telecommunications networks. It was needed to go through live operators to send messages, making the subscription cost very high for such a service.
- Economic: a large proportion of the population still cannot afford the relatively high cost of the Alphanumeric paging services, or the cost of the Alphanumeric pagers, which are sold, not leased or rented in most of Latin America.
- Cultural: paging services do not allow live contact between people as cellular telephony does. From a marketing point of view, this had major influence on the evolution of the market.

At the end of 1996 the number of subscribers to paging services was around 2.4 millions, and that number is expected to grow to 6 million over the next 4 years. At that time, penetration rates will be slightly above 1%, well below the level observed in most advanced countries.

From a technical point of view, almost most of paging systems are using the POCSAG standard, but Motorola's FLEX is already making significant inroad, as it was adopted by several operators in Brazil, Mexico, Columbia, Guatemala, Nicaragua, Puerto Rico and Venezuela.

### **Cordless telephony and wireless local loop**

Wireless Local Loop seems to be very interesting to Latin America because this technology allows expansion of telephone access networks at lower and more manageable costs. The Latin American continent has a lower rate of telephone penetration compared to developed countries. Among the important needed investments for expanding its network, local access is a highlight. Lower prices for local accesses, as the WLL technology permits, will reflect favourably in this development.

The WLL will also allow a more universal service, specially in lower income areas. In these peripheral areas near the urban centres, the high cost of deploying traditional infrastructure has always delayed the expansion of telephony networks. In these areas, WLL investment and maintenance costs are much lower than the traditional copper infrastructure, and furthermore, the system is independent of distances.

DECT and PHS are the two leading technologies implemented for WLL application in the region. However, aside the importance of standards, the need to develop a system with special quality characteristics, similar to copper, resulted in the coexistence of a great number of proprietary technologies among which: AirLoop, of Lucent; GMH2000, of Hughes; DIVA2000, of DIVA; Multigain, of Tadiran; AirSpan, from DCS; and WiLL from Motorola.

#### **4.3.5. Conclusions**

Latin America is expected to offer some of the most significant opportunities for cellular services in the coming years. Increasing economic levels, huge waiting lists to fixed telephone networks and development of competition stimulate overall market development. In addition to that, the wave of PCS licenses currently being awarded are totally technology neutral.

Then market and political environments become the key constraints for EU companies to penetrate this market.

Existing installed base of AMPS and D-AMPS networks should influence the move toward TDMA or CDMA for PCS networks which will have to ensure regional and international roaming capabilities with the USA (all of four Brazilian PCS licensees already choose TDMA, while Iusacell gave a strong push to CDMA in Mexico).

Although the European Union is expected to sign a free-trade agreement with Mercosur in 1999, the region remains largely dominated by the USA from financial and political points of view.

The recent arrival of Chile within the GSM MoU could be the beginning of a more important adoption of GSM standard across that region.

#### 4.4. MOBILE COMMUNICATIONS IN MIDDLE EAST – AFRICA

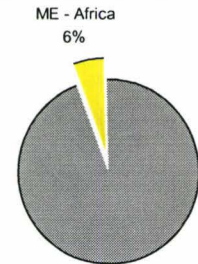
##### 4.4.1. Summary

**Market data**

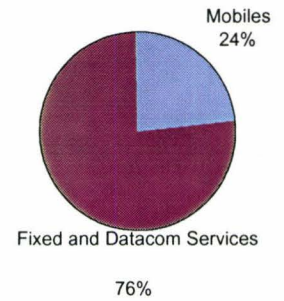
**Telecommunication services revenues and subscribers in Middle East - Africa**

	1986	1991	1996	2001	2006
<b>Market (\$ in billions) :</b>					
Fixed telephony	5.7	11.0	17.3	27.8	44.8
<b>Mobile services</b>	<b>0.0</b>	<b>0.4</b>	<b>6.3</b>	<b>23.4</b>	<b>39.3</b>
Data	0.5	1.2	2.0	3.8	6.5
Others	0.3	0.7	1.2	2.3	3.5
<b>Total</b>	<b>6.5</b>	<b>13.3</b>	<b>26.7</b>	<b>57.4</b>	<b>94.1</b>
<b>Infrastructure :</b>					
ACCESS LINES (MILLIONS)	14.5	26.0	43.2	68.6	114.8
Fixed teledensity (in %)	2.0	3.0	4.4	6.0	8.8
<b>Cellular subscribers (millions)</b>	<b>0.0</b>	<b>0.1</b>	<b>3.8</b>	<b>14.1</b>	<b>52.4</b>
<b>Cellular teledensity (in %)</b>	<b>0.0</b>	<b>0.0</b>	<b>0.4</b>	<b>1.2</b>	<b>4.0</b>

World Mobile Services Revenues - 1996



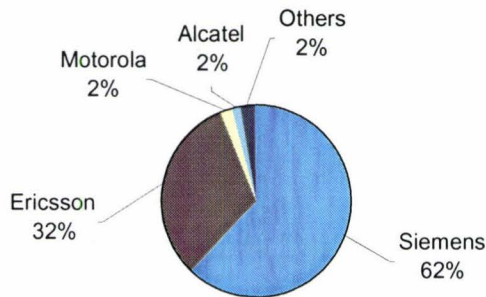
996 Middle East - Africa Revenues



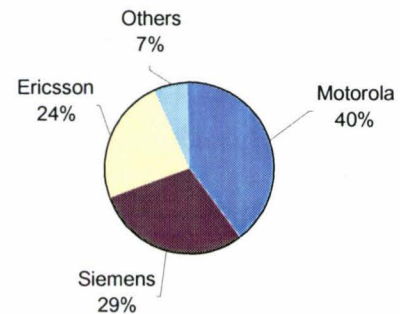
Source IDATE

**Mobile infrastructure equipment manufacturers' presence**

**Mobile switches suppliers - 1997 market shares**  
(Based on the number of subscribers)



**Mobile base stations suppliers - 1997 market shares**  
(Based on the number of subscribers)



Source IDATE & companies reports

**Key facts**

<p><b>Political environment</b></p>	<ul style="list-style-type: none"> <li>- Regional co-operation promoted to develop telecommunications capacities throughout the region. Several programs:             <ul style="list-style-type: none"> <li>- Panaftel: a large and ambitious project to build a large regional telecom networks (including both fixed and wireless technologies).</li> <li>- RTR: Regional Telecommunications Restructuring: a US financed program to set up a modern information infrastructure, and increase interaction between USA and southern African telecom communities.</li> </ul> </li> </ul>
<p><b>Regulatory and institutional environment</b></p>	<ul style="list-style-type: none"> <li>- With a few exceptions, telecommunications management structures are still largely under state administrative and political control.</li> <li>- Telecommunication reforms depend on broader considerations related to liberalisation of the national economy.</li> </ul>
<p><b>Market Environment</b></p> <ul style="list-style-type: none"> <li>- Cellular telephony</li> <li>- Paging</li> <li>- Cordless and WLL</li> </ul>	<ul style="list-style-type: none"> <li>- Mobile services represent 24% of the region's telecom revenues.</li> <li>- Slow take-off, but now becoming widely accepted. 30 African countries has cellular systems in operations at the end of 1996.</li> <li>- Much of the subscriber base concentrated on a limited number of countries in the Middle East and South Africa.</li> <li>- Until 1995, growth has been slow due to high tariffs, security concerns and limited private sector involvement.</li> <li>- The poor state of fixed networks make cellular a good substitute.</li> <li>- Very small market</li> <li>- Marginal business activity for residential cordless</li> <li>- WLL: activity restricted to trials and some contracts. South Africa, Ghana, Kenya and Nigeria represent the areas of greatest activity.</li> </ul>
<p><b>Technologies</b></p> <ul style="list-style-type: none"> <li>- Cellular telephony</li> <li>- Paging</li> <li>- Cordless and WLL</li> </ul>	<ul style="list-style-type: none"> <li>- GSM is the leading digital technology in the region (46% of the subscriber base in 1996)</li> <li>- First CDMA based network launched in Zambia in 1997. Five networks currently deployed in Kuwait and Yemen, Congo and Nigeria.</li> <li>- Analogue systems, ERMES in Saudi Arabia</li> <li>- Analogue and cellular implemented in many cases.</li> <li>- Large contract for DECT in South Africa.</li> </ul>





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#### **4.4.2. Political and institutional environment**

The development of telecommunications in Africa began during the colonial era. Telecommunications was a means to maintain control over the colonial possession and was primarily limited to communications between the capital and its administrative centres within Africa.

As African nations became independent, some saw telecommunications as a tool for development, but full realisation was impeded by significant obstacles, such as the lack of indigenous expertise in telecommunications' manufacturing and research. Since this period, regional co-operation was articulated as a model for African telecommunications development. Since independence, African nations have viewed intra-African telecommunications capacity as essential to their initiatives toward economic, social and political integration, to establish trade and co-operation given the disparate size and level of development of the numerous countries on the continent.

##### **Panaftel**

The most ambitious African telecommunications project to date is the Pan-African Telecommunication Network (Panaftel). It was conceptualised at the Regional Plan Committee for Africa in 1962. Panaftel's implementation, as a co-ordinated and continent-wide project, began in 1975 with the UNDP/ITU project. As of 1990, when the last full-scale inventory of Panaftel was taken, the system consisted of 39000 km of radio relay links, 8000 km of submarine cable, 39 international switching centres, and 42 of the 45 member countries had international satellite stations.

Panaftel, however, has suffered numerous difficulties, principally the lack of co-ordination and co-operation among nations.

##### **RTR**

The ongoing Southern Africa Regional Telecommunications Restructuring (RTR) Program is conducted under the auspices of the Southern Africa Transport and Communications Commission (SATC). The four-year program is funded by the United States Agency for International Development (USAID). SATC is one of several sector-specific commissions of the Southern African Development Community (SADC), which member states are: Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South African, Swaziland, Tanzania, Zambia and Zimbabwe.

The RTR program objective is to help ensure that SADC member states realise the significant economic and social benefits of a modern information infrastructure. It works to:

- deliver technical assistance in support of restructuring efforts, including privatisation, as well as to assist in the resolution of policy and regulatory issues
- promote increased interaction among the US, international and southern African telecommunications communities
- provide management and technical assistance

Regional activities are co-ordinated from program headquarters in Botswana, an information centre based in the USA conducts research and liaison activities.

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All of this points to the fact that Africa still does not have sufficient assets to find a suitable place in the new world configuration, as it is appearing on the horizon. And yet, this is not for lack of initiatives. For instance:

- -Every subregion has its own economic integration structure,
- -The development and integration of telecommunication networks have been given special attention. This has been shown and is still being shown both on an international level, with the ITU, and on a regional level, with the "Missing Link" report, the Arusha Declaration, the setting up of the Telecommunication Development Bureau (BDT), African telecommunication development conferences, the recent establishment of the RASCOM organisation, a number of subregional organisations involved in telecommunications as their main or secondary activity, etc. At the regional level and through the initiative of African governments, the OAU, ITU and ECA, the Pan-African Telecommunication Union (PATU) was established in December 1977 to co-ordinate the development and operation of the regional telecommunications networks and services in a concerted and harmonious manner.

#### **4.4.3. Regulatory environment**

With only a few exceptions (two or three countries), telecommunication management structures are still more or less under State administrative and political control, while in some countries the State still issues instructions for everyday network management.

Even though all the decision-makers are in favour of restructuring the telecommunication sector, views vary on the legal status and capital structure of the new bodies required to operate the telecommunication network. Among politicians, the general view is that the State's monopoly over the network and basic services should be maintained and greater management independence given to one or more public operators; there is also a general tendency in the region towards liberalisation of terminals and value added services.

Nevertheless, under the pressure of events - including the structural adjustment programmes under way in most countries - telecommunication reforms depend on broader considerations related to liberalisation of the national economy.

The lack of outside finance and the insufficient generation of income to cover operating costs have led some States to consider privatising their networks without even knowing the current market value of their assets, which are in fact sold off at bargain prices. When the network management structure is fairly autonomous and allows for private-style management, sale of assets to private parties or the participation of new private partners would pose less problems since the operational indicators would better reflect performance and facilitate asset valuation.

In most cases, the separation of the regulatory body from the network operating body is seldom clear. This limits the scope of measures to liberalise specific services and supplies of equipment.

#### 4.4.4. Market environment

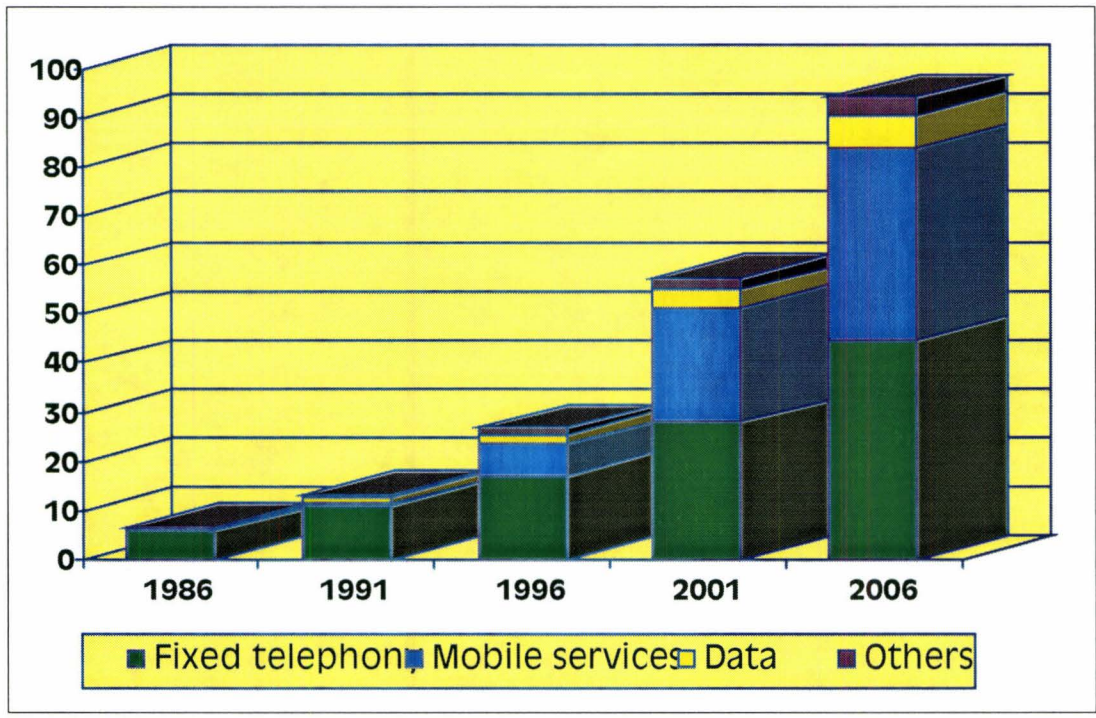
**Cellular telephony services**

**The market**

At the end of 1996, the overall market for mobile communications in the Middle East/Africa region represented about 24% of the region's total revenues for telecommunications, but is expected to rapidly grow over the next 10 years to represent more than 42% of the market at that time.

**Evolution of the telecom services market in Africa-Middle East by sector**

	1986	1991	1996	2001	2006
<b>Market (\$ in billions) :</b>					
<i>Fixed telephony</i>	5.7	11.0	17.3	27.8	44.8
<b>Mobile services</b>	<b>0.0</b>	<b>0.4</b>	<b>6.3</b>	<b>23.4</b>	<b>39.3</b>
<i>Data</i>	0.5	1.2	2.0	3.8	6.5
<i>Others</i>	0.3	0.7	1.2	2.3	3.5
<b>Total</b>	<b>6.5</b>	<b>13.3</b>	<b>26.7</b>	<b>57.4</b>	<b>94.1</b>

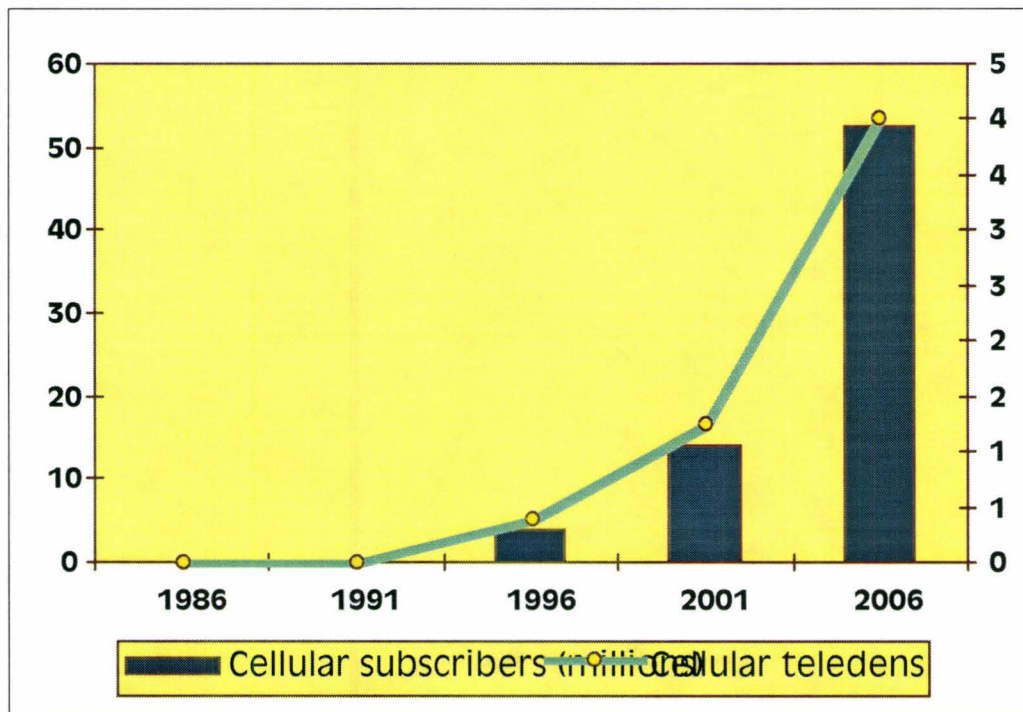


Source IDATE

**Evolution of the telecom services infrastructure in Africa-Middle East**

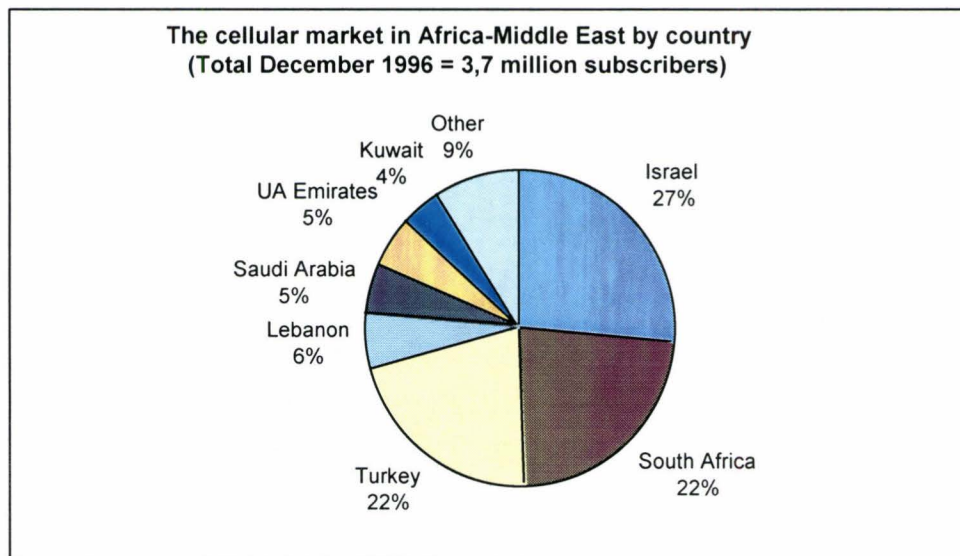
	1986	1991	1996	2001	2006
<b>Infrastructure :</b>					
<i>Access lines (millions)</i>	14.5	26.0	43.2	68.6	114.8
<i>Fixed teledensity (in %)</i>	2.0	3.0	4.4	6.0	8.8
<b>Cellular subscribers (millions)</b>	0.0	0.1	3.8	14.1	52.4
<b>Cellular teledensity (in %)</b>	0.0	0.0	0.4	1.2	4.0

Source : IDATE



Mobile communications, though slow take-off in Africa, is now becoming more widely accepted. Some 30 African countries had cellular systems in operation at the end of 1996. However, until now the installed base of subscriber is still very much concentrated on a limited number of countries in Middle East and South Africa.





In South Africa the growth has been explosive since the launch of a GSM system by two competitors in 1994. In August 1997, the first CDMA network in Africa was launched in Zambia.

However until 1995, growth of mobile cellular in the region had been slow, considerably lower than the world average. This was due to a number of factors:

- Security concerns : this was the case of Algeria and Egypt.
- High tariffs: while analogue networks were running at close to capacity, there was little incentive to charge low tariffs. Tariffs for GSM are significantly lower.
- Limited private sector involvement: it is noteworthy that in the largest cellular markets, Israel, Kuwait, Lebanon, UAE, private investors are involved in providing service.

Middle East has seen a tremendous growth of mobile communications in the last years (+100% of cellular subscribers in 1996). One of the main factors is the take-off of GSM in the region since the launch in 1994 of the first network in Qatar. In 1995 and 1996, practically all new subscribers signed up for GSM networks. Take-up in Israel, Turkey, Lebanon and Saudi Arabia has been particularly impressive.

Cellular is one of the few market segments where private investment and competition has been allowed in the African telecommunication sector.

Foreign partners mostly come from Europe and have generally already launched GSM services. The main American partner is Telecel, which operates several networks including Burundi, Central African Republic, Guinea, Madagascar, Zaire, Zambia. Telecel operates AMPS network and is expected to launch digital systems based on the CDMA standard to upgrade its networks.

Sub-Saharan Africa is an ideal environment for cellular technology. The poor state of fixed networks make cellular -with quicker installation times and competitive investments costs- a good substitute.

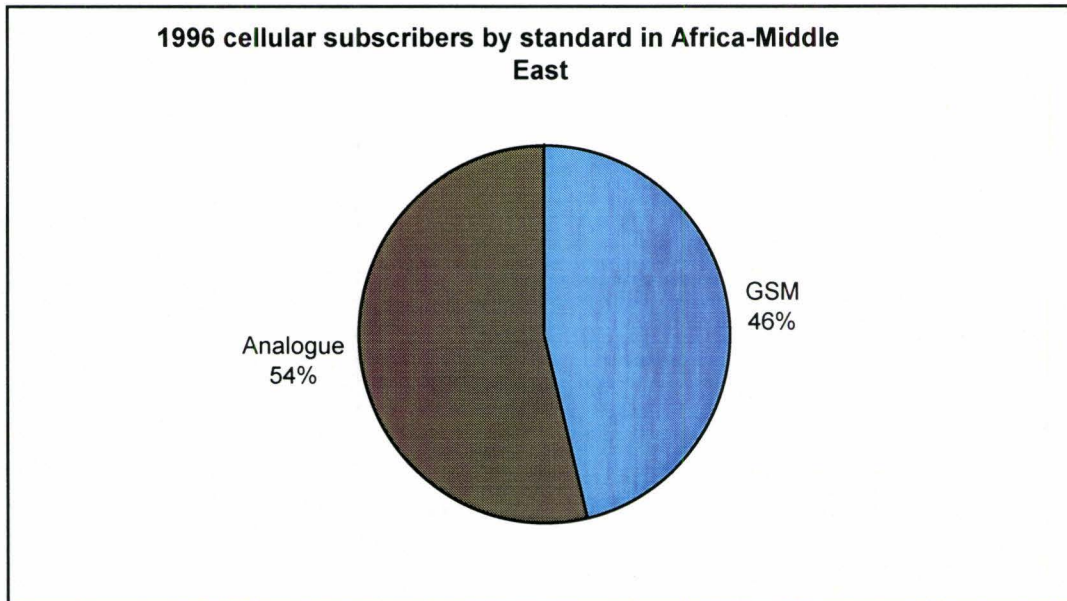
#### **The Middle East – Africa fixed network**

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	<b>Waiting list (in thousands)</b>	<b>Main lines (in thousands)</b>	<b>Waiting time (years)</b>
South Africa	133.2	3844.5	1.0
Gambia	19.5	18.3	>10
Senegal	14.4	82.0	1.8
Cameroon	42.0	59.7	>10
Côte d'Ivoire	55.6	115.8	5.6
Kenya	70.6	239.6	6.6
Egypt	1310.2	2716.2	5.7
Kuwait	2.6	382.3	0.2
Morocco	93.3	1157.5	0.6
Saudi Arabia	1262.5	1898.6	>10
United Arab Emirates	1.3	672.3	0

**The technologies**

	1991	1992	1993	1994	1995	1996
Analogue	192 967	248 852	369 494	560 408	1 194 734	2 012 280
GSM	7 100	12 510	40 000	271 667	781 497	1 725 720
Total	200 067	261 362	409 494	832 075	1 976 231	3 738 000



**Paging services**

Paging is an underdeveloped market in that region. Very few networks are running, and most of the subscriber base is located in Saudi Arabia where an ERMES network had about 500.000 subscribers at the end of 1996.

**Cordless telephony and Wireless Local Loop**

The Middle East / Africa region has the lowest growth rate for WLL. However some networks are up and running, and few countries already represent potentially good opportunities. They are, Zimbabwe, which has 20,000 WLL lines running, Egypt, Namibia, or South Africa. In the latter, Telkom South Africa WLL plans of expansion have started with a contract which covers over 420,000 subscriber lines using DECT. It is the largest WLL contract ever awarded to any WLL technology in the marketplace so far.

In Egypt, Egypt Telecom has launched a very ambitious program to double telephone capacity in the country over the next five years, aiming at up to 800,000 lines. DECT WLL systems have been selected as the wireless access solution for this project.

By contrast there is currently very little WLL activity in the Middle East.

#### **4.4.5. Conclusions**

The development of telecommunications is very heterogeneous across the region. The very low economic level of some countries, the remaining monopolies in most countries and major issues around political stability and security, are serious brakes to the development of telecommunications in general. Nevertheless, significant opportunities are expected in most richest countries (Middle East, South Africa), where EU companies can play a key role.



## 5. THE GLOBAL MARKET FOR DIGITAL MOBILE COMMUNICATIONS: IDENTIFICATION OF OPPORTUNITIES AND CONSTRAINTS.

### 5.1. INTRODUCTION

The world industry for mobile communications, succeeded to become in less than twenty years the leading segment of the global telecommunications in terms of growth rate, and is expected to represent more than half of the world-wide installed base of subscribers to fixed telecom services less than 10 years from now.

The major trends we have identified can be grouped into the following domains:

- Market demand
- Technological evolution
- Companies' strategies
- Regulation and liberalisation
- Political organisation and strategies.

### 5.2. CELLULAR TELEPHONY SERVICES

#### 5.2.1. Market demand

Over the last ten years, the world market for mobile communications recorded growth rates, any industry experienced before. For the foreseeable future, such a trend is expected to at least continue or even accelerate, as most countries are still very far for maximum penetration rates.

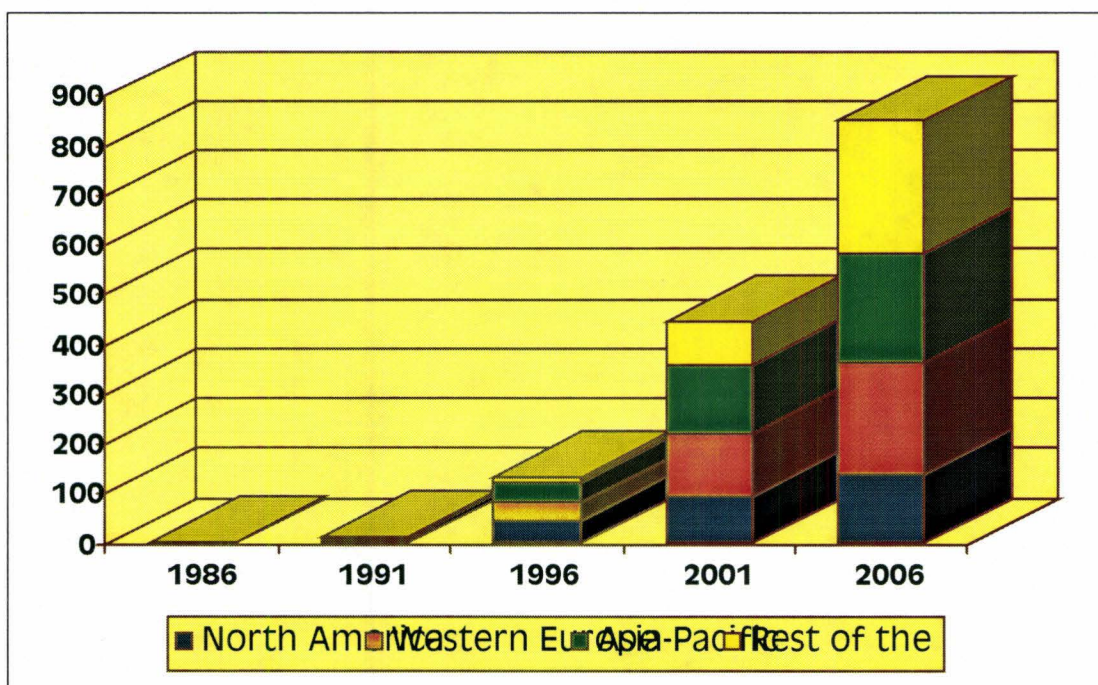
Regarding the evolution of subscribers, IDATE estimates that by the end 2001 about 450 million people will be subscribing to a cellular telephony service, tripling the 1996 installed base, and that five years later, this figure will almost double, with 400 millions more joining the "club".

#### Evolution of the number of cellular subscribers by geographical area (in millions)

	1986	1991	1996	2001	2006
North America	0.7	8.4	47.7	96.2	138.4
Western Europe	0.5	4.4	35.3	125.2	224.1
Asia/Pacific	0.1	3.0	40.6	136.8	220.3
Central and Eastern Europe	0.0	0.0	1.5	24.6	75.1
Latin America	0.0	0.3	6.8	51.6	139.6
Africa/Middle East	0.0	0.1	3.8	14.1	52.4
<b>Total</b>	<b>1.3</b>	<b>16.2</b>	<b>135.7</b>	<b>448.5</b>	<b>849.9</b>

Source : IDATE





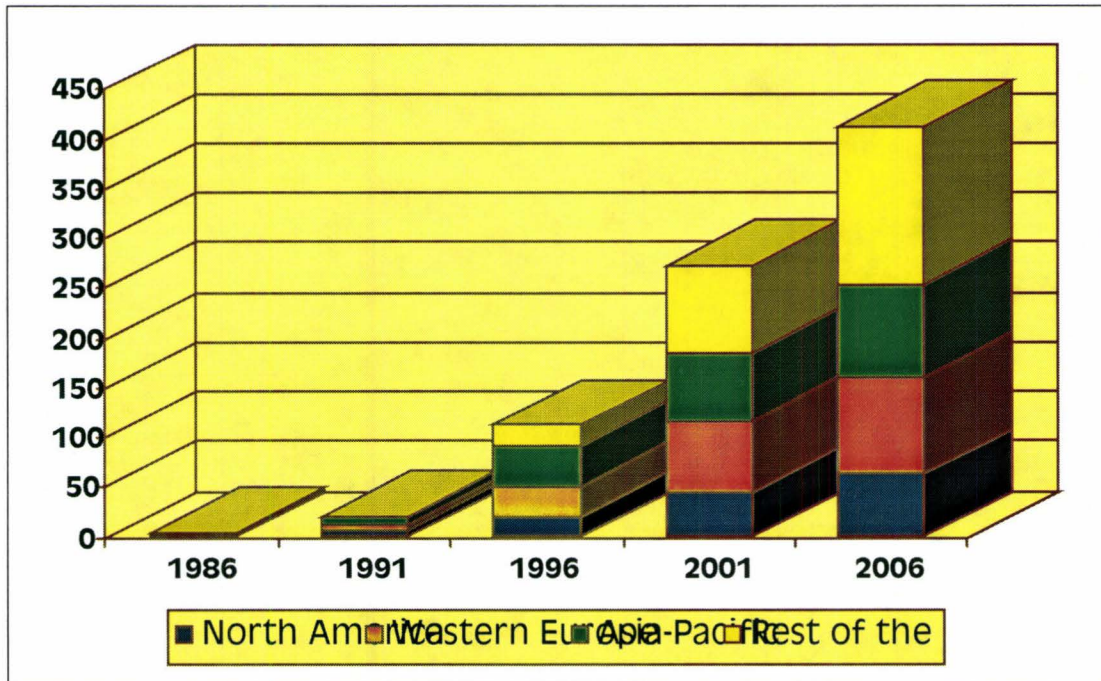
Source : IDATE

As a consequence revenues generated by such a level of subscription will also record tremendous growth during that period going from 113 billion dollars in 1996 to 274 billion in 2001 and about 413 billion in 2006. At that time, revenues from mobile services will represent 2/3 of those generated by traditional fixed line telephony services.

**Evolution of the world mobile services market by geographical area (\$ 1996, in billions)**

	1986	1991	1996	2001	2006
North America	1.3	6.2	20.4	46.6	63.6
Western Europe	1.3	7.3	29.8	70.0	97.5
Asia/Pacific	1.4	7.0	42.6	69.5	92.7
Central and Eastern Europe	0.0	0.0	2.5	20.8	42.0
Latin America	0.0	0.5	11.3	43.6	78.0
Africa/Middle East	0.0	0.4	6.3	23.4	39.3
<b>Total</b>	<b>4.0</b>	<b>21.5</b>	<b>112.9</b>	<b>273.9</b>	<b>413.1</b>

Source : IDATE



Those figures give a flavour of the size of what many industry analysts now called the golden mine of telecommunications.

Although analogue systems continue to hold a large share of world subscribers, especially in market such as the USA, digital technologies will clearly command the highest stakes for cellular future. Consequently, business opportunities for all players (operators and equipment manufacturers) will be numerous:

- **growing number of new networks**, as all countries are deregulating their market to have at least two or three competing operators.
- **growing size of networks**: starting with few thousands, most networks are growing rapidly to millions of subscribers, meaning a strong need to expand the network capacity as well as coverage. From a business opportunity point of view, according to industry experts, an average value of 350 to 400\$ per subscriber can be considered to estimate the amount needed to set up and expand a cellular network.
- **growing need for services**: in most advanced countries, the need of each operator to differentiate from its competitor, leads to development of new functionalities, integrating more and more multimedia capabilities
- **competing with fixed line**: in many developing countries, mobile communications is a faster and less expensive way to start solving their waiting list problems.
- **On the handsets side**, the total number of digital handsets is expected to go from about 60 million units in 1996 to more than a hundred millions units per annum over the 1998-2002 time frame.



However as things are moving very quickly in that industry, current leaders of a market being one third of that 3-4 years from now, may no longer be on the top at that time if they do not anticipate and react quickly to market evolution.

### Opportunities and constraints from the market demand

Concerning the market environment trends, major opportunities and constraints have been summarised in the following table.

	Opportunities	Constraints / Threats
<b>Western Europe</b>	<ul style="list-style-type: none"> <li>- Continuous growth of subscribers' base.</li> <li>- Evolution toward third generation systems.</li> </ul>	<b>Uncertainties about market expectations for new services (3<sup>rd</sup> generation).</b>
<b>Central and Eastern Europe</b>	<ul style="list-style-type: none"> <li>- Lack of fixed networks.</li> <li>- Need for modern telecom infrastructures.</li> </ul>	<ul style="list-style-type: none"> <li>- weak economies</li> <li>- low GNP/inhabitant</li> </ul>
<b>North America</b>	<ul style="list-style-type: none"> <li>- Continuous growth of subscribers.</li> <li>- Slow migration toward digital systems.</li> </ul>	<b>Very hard competitive pressures,</b> requiring large investment to keep leadership and differentiation on products.
<b>Latin America</b>	<ul style="list-style-type: none"> <li>- Huge potential and expected growth of subscribers,</li> <li>- Rapidly developing economies.</li> <li>- Lack of fixed networks.</li> </ul>	<ul style="list-style-type: none"> <li>- LOW GNP/INHABITANT</li> <li>- Domination of US standards.</li> </ul>
<b>Asia / Pacific</b>	<ul style="list-style-type: none"> <li>- World's largest potential market.</li> <li>- European technologies and companies widely present.</li> </ul>	<ul style="list-style-type: none"> <li>- Economic level of several countries will slow market evolution.</li> <li>- Increasing competitive pressures from Japanese companies.</li> </ul>
<b>Middle East / Africa</b>	<ul style="list-style-type: none"> <li>- Market concentrated on few rich enough countries.</li> </ul>	<b>Economic weakness</b> and political instability.

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### **5.2.2. Technological evolution**

Mobile telephony heavily rely on technology. The very fast growing trend followed by the industry, makes technologies becoming obsolete at least as fast as in the personal computer industry. Understanding the move toward next generations of systems is essential to highlight potential opportunities and threats for European companies.

<b>The future of GSM</b>
--------------------------

#### **The "phases" of the GSM standard:**

ETSI is improving the GSM standard in a continuous process by adding new features and services. Phase II+ is going to be implemented soon and will add new functionalities such as packed data and higher data transmission rates which will increase the attractivity of GSM for "multimedia-type "applications.

**Data transmission** on GSM networks: existing services will be improved by GPRS and HSCSD.

Current data transmission capabilities on GSM are generally limited to 9.6 Kbps (or 14.4 Kbps).

GPRS (General Packet Radio Service) was agreed by the GSM/MoU (Memorandum of Understanding) as a key link between GSM and the UMTS (Universal Mobile Telecommunications Standard). Many of the characteristics of GPRS (e.g. packet based, transport, new control, overlay network to GSM) are also very relevant for UMTS.

HSCSD (High Speed Circuit Switched Data) will enable higher transmission rates on GSM networks: up to 38,4 Kbps using a combination of four GSM time slots.

#### **Network subsystem**

- CAMEL (Custom Application for Mobile networks Enhanced Logic) will provide the necessary functions in the GSM system to offer Intelligent Network features within the GSM networks. CAMEL is part of the GSM phase II+ enhancements.
- ETSI has already developed technical standards in order to enable interworking of GSM networks with DECT systems. DECT can be a very interesting radio access system in business areas requiring high density of traffic.

#### **Radio subsystem**

- The use of new coding and modulation techniques on the GSM radio interface, planned for phase II+, will enable the support of higher data rate (115 – 384 Kbps).

#### **GSM combined with other technologies**

As GSM networks experience congestion in some cities in western Europe, cellular operators envisage use of dual-mode or dual-band terminals as solutions to this problem.

Key of the evolution of second generation systems will be the development of dual-mode and dual-band terminals which will enable users to hop between systems while keeping the same telephone number and

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the same handset. Initial user studies indicate that combined DECT/GSM service increases traffic, and provides more confidence to users that they can be reached 100% of the time.

#### ▼ GSM and DECT

DECT appears as an ideal complement to GSM as it can provide a solution to capacity problems in high-density areas. First, DECT could be used as a micro or pico cellular extension of a GSM network. In this configuration, DECT would serve as a radio access system.

The second potential use of DECT is as wireless extensions of PBX in corporate networks. The same dual-mode terminal could be used:

- to access the fixed network when the user is located within the company's premises;
- to make and receive calls on the GSM network when the user "roams" outside.

This combination would enable European technologies to compete with CDMA as they would allow high capacity systems to be implemented in congested areas.

As part of the extension of the DECT standard called GAP (General Access Profile), the DECT/GSM interworking profile specification was developed by ETSI in order to facilitate the combination of the two standards.

GSM/DECT trials have been carried out by European operators such as Telia in Sweden or Mannesmann in Germany but it seems that it is too early to state that there is a real market for GSM/DECT dual-mode handsets.

#### ▼ GSM and GSM 1800

GSM/DCS 1800 is seen to have a large market potential due to the existing and pending volume of subscribers. Many GSM operators, faced with congestion problems, are trying to get DCS 1800 frequencies from their regulators. Sweden and Denmark are among the first countries where GSM operators have been licensed for use of DCS 1800 frequencies.

#### ▼ GSM and PCS 1900

GSM/PCS 1900 dual-band handsets will increase the attractiveness of PCS 1900 in the USA enabling North-American subscribers to use their terminals in foreign countries. Tri-band (GSM/DCS 1800/PCS 1900) are also envisaged by manufacturers.

#### ▼ GSM and PHS

Several Asian manufacturers are developing dual-mode GSM/PHS terminals in a move to promote the PHS technology in Europe.

This combination does not seem to represent an interesting market potential for European manufacturers as almost all of them do not support the PHS technology (the exception being Alcatel which, according to an Alcatel representative in Japan, is currently planning to move into PHS equipment in the short term).

### **The growing importance of new technologies.**

Major competitive technologies are now challenging GSM leading position on the world market for mobile communications. They now represent real threats to GSM, although none of them have the critical mass, openness and technical strengths GSM has.



**CDMA**

CDMA (Code Division Multiple Access) is a radio access method as are TDMA (Time Division Multiple Access) used by GSM and FDMA (Frequency Division Multiple Access). There is a lot of confusion about CDMA: it is basically a radio air interface but people tend to associate it with the standard developed by Qualcomm, called IS-95 CDMA. This one is based on a narrowband CDMA (N-CDMA) specification and does not allow higher user data rates than GSM (approximately 9.6 Kbps). Third generation mobile systems are likely to use the CDMA access mode but in a wideband version (W-CDMA) which will allow higher data rates up to 2 Mbits/s.

<b>Standard</b>	<b>Access method</b>
GSM	TDMA
IS-136	TDMA
IS-95	CDMA
UMTS	W-CDMA or combined CDMA/TDMA

**Asia-Pacific**

Through the IS-95 standard, the CDMA technology is starting to make some inroads into the Asia-Pacific market, due in particular to its image of superior radio spectrum efficiency, that ensures higher capacity. CDMA IS-95 based services therefore appeal in countries with high population density, with so far Hong Kong and South Korea having launched such commercial services.

In fact, the world's first three commercial services based on CDMA have been deployed in Asia. It was in Hong Kong that Hutchison Telecom launched the world's first CDMA based services in September 1995 on a network supplied by Motorola. And in 1996, Korea's 2 mobile operators, SK Telecom (formally Korea Mobile Telecom or KMT), and Shinsegi, launched the world's second and third CDMA services.

At the end of 1996, Korea's 900,000 CDMA subscribers represented the overwhelming bulk of the world's CDMA subscribers, estimated at 1 million as of the end of December 1996, with the remaining part being split between Hong Kong and the US.

New CDMA networks are scheduled for deployment in Korea, Japan, Thailand, Indonesia and the Philippines, with the system also being experimented in China.

In Japan, in order to cope with an explosive growth, the limited radio spectrum resources, and the demand for high transmission speed for mobile computing, the MPT and NTT DoCoMo decided upon the implementation of the CDMA technology.

Among the operators, IDO and DDI Cellular, both of which already Motorola's customers, have also officially announced in 1996 that they will introduce new services based on the CDMA technology. The first CDMA based cellular service is expected to start in 1998.

An official reason for choosing IS95 rather than GSM is the perceived higher spectrum efficiency (an argument which is debated between proponents of both technology communities). Furthermore, the GSM radio spectrum is already allocated to military use. Another stated reason is that 60% of PCS operators in the US have chosen CDMA, and that operators in Germany, where the GSM is widespread, also started to

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implement it on an experimental basis. However, observers largely consider this move as a political decision and an attempt to soften US-Japan trade relations.

### North America

CDMA's strength in North America is to be presented and marketed as a US technology. However, CDMA is not considered as a threat, neither for up-banded TDMA nor for GSM, because it will have to go through the same running-in period, before it reaches maturity, and this will take time. The advertised CDMA advantages, like better voice quality and higher capacity, still have to be proved in the field.

In North America, CDMA has been marketed as superior to all other digital wireless formats, in terms of voice quality, capacity, economics and ease of implementation. However, actual tests prove that these advantages are often far from what had been advertised. The most disappointing (and damaging financially speaking) is the number of cell sites actually required for a good quality network. A CDMA system was initially supposed to require only 50% to 80% base stations than other digital systems. In fact, CDMA operators (Air Touch, PrimeCo, Ameritech, etc.) have discovered that, in high traffic areas, they had to almost double the number of cell sites to maintain good quality services. Considering the cost of a single cell site (US\$ 400,000 to 500,000 for hardware, software, site acquisition and legal fees), this is creating critical financial difficulties for some of them. This also slows down the deployment of these networks, as is the case of Nextwave for instance, who has a financial dispute with the FCC over the payment of the auction fees.

### Latin America

Although TDMA technology seems to have the edge in Latin America as a whole, the fact that CDMA is emerging as the favoured standard in the USA and Canada means both systems seem likely to win strong support. In Brazil, all four successful B-Band cellular bidders are going with TDMA. On the other hand, in Mexico, CDMA has received a big boost when country's second-largest operator Iusacell decided to upgrade its analogue system using CDMA technology. In Chile where licences were awarded last year, operators have chosen GSM1900 and CDMA1900.

However as the auction process is still not at the end, standard decisions are yet to be finalised. But as end users don't really care about what the technology implemented is, the major factor certainly is the generosity of equipment suppliers in terms of financial support to new operators.

### Europe.

Although Japan and the US are pushing very hard their respective technologies (CDMA, PHS, etc.) to catch back their position in the Asia Pacific region, the homogeneity of the systems implemented in Europe leaves almost no space to competing standards today.

The European market should not be threatened in the short term. But in the longer term, it is clear that CDMA must be considered more as a technology to be part (because CDMA is only an Air Interface) of the next generation systems allowing multimedia and broadband communications.

According to Qualcomm, CDMA alone has no market opportunities in Europe: European carriers cannot select the technology they want (contrary to US carriers) and GSM is now too well implanted world-wide with over 50 million subscribers and a good service.

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The CDMA strategy to penetrate Europe will rather consist into offering a combination of the IS-95 air interface (Qualcomm proprietary standard) with the use of the GSM core network. This project is being tested by Qualcomm and Vodafone (UK).

CDMA is also expected to make inroads into Europe through the Wireless Local Loop market, where it can offer today significant capacity capabilities.

### **Third generation systems**

Until now, mobile communications services have been based on different heterogeneous analogue and digital systems, all having a well defined regional brand.

The framework the ITU wants to put in place as the basis of the third generation system clearly illustrates the move towards a world global market. The model wants to provide both operators and equipment manufacturers with a single set of elements with which all various regional standards for the third-generation system must be compatible. For this approach to work, the various standards must all comply with a basic set of requirements so that they can all interwork in one global system.

However, although the ITU model contains the raw materials on which the system will be based, the industry still has to come together to discuss the details. But there does appear to be a broad industry consensus that the will is now there to work towards the development of IMT-2000. This appears to be confirmed by the fact that co-operative talks between the various regional standards bodies have already started.

According to some experts, the core infrastructure component of IMT-2000 is expected to evolve from two standards: GSM and US D-AMPS, while the radio interface component will incorporate four or five regional standards.

In that respect, the move toward the third generation systems can be considered both as a threat to EU companies as it will intensify competition on all markets, and as an opportunity if GSM will be one of the key parts of those new systems.

#### **Overview of regional development of third generation systems.**

##### *Development in the USA.*

Curiously, the country which has historically played a key role in the development of new wireless technology, the USA, is not likely to be looking at third generation until some time after the Europeans and Japanese have launched commercial systems. A combination of inter-standards rivalry and delays in developing commercial products has hindered deployment of digital cellular in North America. The market is lagging behind Western Europe and Asia Pacific by three to five years. North American operators, particularly the new PCS operators, are too deeply committed to deploying their second generation networks and trying to capture market share to spend time and resources on third generation. In addition to that, from a standard point of view, most of US operators want to find as many solutions as possible to the churn problem. Standard differentiation and heterogeneity is clearly one of them. In that respect, a move toward a more 'unified' world doesn't seem realistic in short and medium term.

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The issue is further complicated by the decision of the FCC to auction parts of the WARC-allocated third generation spectrum for PCS operations. Few US operators believe that further spectrum will be made available in the near to medium term and 2004 is being suggested as the earliest possible date for the introduction of third generation in North America.

Different technologies are currently being developed as third generation systems. The United-States have been implementing second generation systems very recently. In that respect, major trends in terms of third generation are twofold:

- regulatory and standardisation issues should be close, from a global point of view, to those used for PCS
- the position of PCS operators regarding third generation is clearly conditioned by their existing technical solution: CDMA operators are expecting third generation to be an evolution of CDMA and IS-41 network, while PCS1900 operators want third generation to evolve from GSM.

Work around standards didn't progress very much in the USA, and co-operation with other regions (ETSI in Europe and ARIB in Japan) still remain at an 'administrative' level (apart from the continuous co-operation between ETSI and T1P1 ensuring there is only one coherent GSM standard in the US and Europe).

### Development in Japan

In Japan, as Japanese manufacturers were unable to win business in the booming second generation digital cellular because of their decision to develop a Japan-only technology – PDC. Japan was keen not to miss the bus on third generation, hence NTT DoCoMo's development plans, with proposals to trial its W-CDMA system early in 1998 with commercial deployment in 2000.

Japan defined a very ambitious calendar for the implementation of a third generation mobile system. The standardisation work is currently performed under the ARIB responsibility (Association of Radio Industry and Business). Preference has been given to Wideband CDMA radio interface.

The following characteristics have been defined:

- Japan wants to have a third generation system which could quickly be deployed at a world-wide level, and which offers international roaming capabilities.
- As MPT doesn't plan to extend spectrum allocated to PDC, considering the very rapid growth of the Japanese market, a new system has to be implemented by 2000.
- Japan is investing heavily into the FPLMTS and the national standardisation J-FPLMTS
- Japan developed a three phases approach for J-FPLMTS
  - Phase 1: base system similar to PDC/PHS (year 2000)
  - Phase 2: few hundreds of Kbit/s for data transmission (year 2003-2005)
  - Phase 3: broadband (2010)
- an agreement has been signed to have roaming capabilities between Japanese and South Korean systems in 2002.

NTT DoCoMo is driving development, and selected the following equipment suppliers to provide test equipment:

- for base station: Ericsson, Fujitsu, Lucent, Matsushita NEC
- for handsets: Motorola, Nokia, Toshiba, Sharp, Mitsubishi, Matsushita NEC

Telecom Finland is associated to NTT DoCoMo for these development.

Development in Europe

Because of the world domination of the GSM standard for digital mobile networks, the development around third generation in Europe are of key importance to hundreds of operators currently operating a GSM network. Development activities are handled by ETSI from a standard point of view with in-depth involvement of the UMTS Forum organisation, and the European Commission from a regulatory point of view.

The European proposal for third generation, known as UMTS, first generated five different proposals of technical solutions:

Europe (ETSI) UMTS	<p><i>Alpha group:</i> W-CDMA</p> <p><i>Beta group:</i> Orthogonal frequency division multiplexing (OFDM)</p> <p><i>Gamma group:</i> Wideband TDMA</p> <p><i>Delta group:</i> Wideband TDMA/CDMA</p> <p><i>Epsilon group:</i> Opportunity driven multiple access</p>	<p>Ericsson, Nokia, Siemens, Alcatel Fujitsu, NEC, Panasonic Sony, Telia, Lucent Technologies</p> <p>France Telecom, CENT, Siemens Philips</p> <p>Siemens, France Telecom, CNET, Nortel, Alcatel, Italtel</p> <p>Vodafone</p>
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After several months of intensive lobbying, rival groups agreed on January 29<sup>th</sup>, to collaborate on the establishment of a common air interface, although the agreement fell short of providing very much details. For the time being, the compromise defined the main boundaries between the two leading systems:

- W-CDMA being adopted for wide area networks with high mobility capabilities
- TD-CDMA being restricted to more private environments and low mobility capabilities.

From a regulatory stand point, the European Commission recently announced its proposal for the co-ordinated introduction of UMTS in Europe. EC's proposal has four major steps:

- Member states have to put into place a harmonised system for authorising UMTS systems by Jan. 1, 2000, to allow these services to begin in 2001.
- UMTS licensing should seek to ensure the development of pan-European services, which implies that the licensed systems should support roaming.
- Authorisation systems applied by EU members must take into consideration standards developed by ETSI, with particular importance placed on a common, open and internationally competitive air interface standard.
- The timely availability of spectrum achieved by way of mandates given to the CEPT.

Within Europe, the UK can be considered as the most advanced European country regarding the implementation of UMTS on its mobile market. Works around UMTS started in February 1997, with the working document prepared by the UK "3<sup>rd</sup> Generation Mobile Group". That document generated comments until May 31 1997, which led the publication of the "Multimedia communications on the move", by the DTI (Department of Trade & Industry).



DTI proposed the following orientations:

- sell frequencies during fiscal 1998-1999 years to three national operators.
- Allocate 2x20MHz by operator initially
- The four existing cellular operators will be allowed to participate to the auction
- DTI supports the UMTS positioning within the IMT 2000 framework
- DTI supports the ETSI approach for the UMTS standardisation
- Licensed operators will have to cover 80% of the territory six years after the award of the license.
- Licenses will be awarded for a 15 year period.

The DTI is expected to publish a new document at mid-1998. Specific decisions are expected to be part of this document, notably about spectrum allocation, number of operators, the role of service providers, national roaming issues and the possibility for GSM operators to have UMTS licenses.

### Opportunities and constraints from the technological evolution

Concerning the market environment trends, major opportunities and constraints have been summarised in the following table.

	Opportunities		Constraints / threats
	2 <sup>nd</sup> Generation	3 <sup>rd</sup> Generation	
<b>Western Europe</b>	<ul style="list-style-type: none"> <li>• New releases of GSM.</li> <li>• Remaining GSM 1800 licences to be awarded</li> <li>• Data communications capabilities.</li> </ul>	<ul style="list-style-type: none"> <li>• Migration toward 3<sup>rd</sup> generation systems.</li> </ul>	<ul style="list-style-type: none"> <li>• The need of a homogeneous move toward 3<sup>rd</sup> Generation.</li> <li>• The actual market demand for new services.</li> <li>• The strength of US networking companies in IP based equipment.</li> <li>• 3<sup>rd</sup> generation IPRs.</li> </ul>
<b>Central and Eastern Europe</b>	<ul style="list-style-type: none"> <li>• Market leadership of western European technologies.</li> <li>• Additional GSM 1800 licences in 10 countries applying to enter EU.</li> </ul>		
<b>North America</b>	<ul style="list-style-type: none"> <li>• Rapid deployment of PCS1900 based networks</li> <li>• Growing number of members to the GSM Alliance.</li> </ul>	<ul style="list-style-type: none"> <li>• No existing barriers for UMTS as preferred 3<sup>rd</sup> generation solution.</li> </ul>	<ul style="list-style-type: none"> <li>• Rapid deployment of competing technologies (CDMA/TDMA) supported by 4 major equipment suppliers.</li> <li>• IMT-2000 frequencies already partially awarded to PCS operators.</li> </ul>
<b>Latin America</b>	<ul style="list-style-type: none"> <li>• Adoption of GSM in Chile and Paraguay.</li> </ul>		<ul style="list-style-type: none"> <li>• Market leadership of US standards for PCS networks (notably Brazil and Mexico).</li> </ul>

			<ul style="list-style-type: none"> <li>• Need for cross-border compatibility of standards.</li> </ul>
<b>Asia / Pacific</b>	<ul style="list-style-type: none"> <li>• Strong presence of GSM across the region.</li> <li>• New releases of GSM.</li> </ul>	<ul style="list-style-type: none"> <li>• Closer relationships developed with Japan for 3<sup>rd</sup> generation works.</li> <li>• Short term needs in Japan.</li> </ul>	<ul style="list-style-type: none"> <li>• Growing number of CDMA based networks.</li> <li>• Move towards not compatible 3<sup>rd</sup> generation standards.</li> </ul>
<b>Middle East / Africa</b>	<ul style="list-style-type: none"> <li>• Official adoption of GSM by the Arabian League.</li> </ul>		

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### 5.2.3. Companies' strategies

#### Equipment manufacturers

Thanks to the GSM standard strengths, EU equipment suppliers currently have a leading or strong presence on almost all world's markets (except Japan) both for terminal and network infrastructure equipment. However, **market demand and regulatory constraints are driving their strategies. Generally speaking, they want to be able to provide any system for which they think there is or there will be a market.**

- Swedish **Ericsson** decided to develop products in all technologies (except IS 95 CDMA and PHS), in order to be able to address any market directly. The Swedish is the only European manufacturer having a strong presence in Latin America and is now the world's market leader for mobile network infrastructures.
- **Nokia**, the Finnish manufacturer is mainly concentrating on the GSM Family type of products, although it developed its presence in Japan through a joint venture with Mitsui Corp, to sell PDC terminals. More recently, Nokia also decided to develop a line of terminals using the CDMA technology.
- **Alcatel and Siemens**: those two manufacturers which led the European telecommunications market for many years, decided to address aggressively mobile communications markets, much later than the others, and are experiencing hard times to catch back. Both of them are only focusing on the GSM family range of equipment. However, in order to be present on others' technologies market, they have concluded strategic alliances with other manufacturers: for example Alcatel signed an open co-operation agreement with Motorola to have a CDMA offering (Motorola providing Radio Interface and Alcatel switches), and with Hughes Network Systems for D-AMPS systems.
- American manufacturers **Motorola, Nortel and Lucent Technologies** have been selling both GSM CDMA and TDMA systems depending on region. According to Motorola Hong Kong, the manufacturer does not promote one technology more than another, it only adapts to business opportunities. For example, the GSM infrastructure division of Motorola has not been able, for a long time, to make business in North America. The growing importance of PCS1900 operators and opportunities recently changed that situation.
- On the terminal side, the recent joint venture between **Philips and Lucent Technologies** will open the North American market and standards to the Dutch manufacturer, while increasing Japanese companies are now manufacturing GSM terminals notably in Europe.

The move towards a new generation represent a major challenge to all manufacturers, with associated opportunities and threats. Generally speaking, for the time being, all manufacturers are pushing towards standards having maximum compatibility across the world (to ensure volume markets). To do so Ericsson and Nokia joined Japan's 3rd generation cellular project very early. They consider that Japan has a significant head start in devising an international standard for such system, and that the Japanese system

will eventually become the only or one of two or three international standards. Therefore, they want to be part of it. They are supporting the idea that Japan and Europe should co-operate, otherwise it will be the US that will join hands with Japan, and this will work against Europe.

This highly contributed to the closer co-operation now established between ETSI and ARIB, and to ensure the very high positioning of UMTS within the future IMT 2000 framework. However, although EU and Japanese manufacturers seemed to agree on a common approach for the radio interface part, major issues around the way to handle International Proprietary Rights remain unsolved.

More precisely, as both the Japanese and the European systems will use the same frequency band, they promote the idea that wideband CDMA should be used for the air interface, while the European know how gained with GSM could be used for the network side.

Interestingly, this idea also seems supported by US-based Qualcomm, that offers only CDMA technology, and is also trying to promote the idea of integration between CDMA technology, for the air interface, and GSM, for the infrastructure network.

On the Japanese side, as Japan failed to export its PDC technology, Japanese manufacturers have been notably absent from the world market for mobile network equipment. As they could no longer ignore the current growth of competitive technologies, notably the GSM standard, a number of them have started to manufacture GSM terminals. Among these, Mitsubishi Electric has been producing GSM handsets in France, for both the European and Asian markets. Similarly, Matsushita Communications and NEC have been producing GSM handsets in the UK, and companies like Kenwood are planning to follow suit. Kyocera on the other hand plans to set up such facilities in China a low labour cost region that it also expects will be a high growth market.

## Operators

Generally speaking, European operators' policy is not necessarily to support European technologies or standards rather than others. They are rather inclined to follow operators or regulators decisions. However, apart from the Telefonica case in Latin America, no European operator acquired a significant equity share in an operator running a non European standard based network.

Operator	International presence (outside Europe)
Vodafone	Australia (GSM), Hong Kong (D-AMPS, DCS-1800), Fiji (GSM), South Africa (GSM), Uganda (GSM)
France Télécom	Lebanon (GSM), India (GSM), Ivory Coast (GSM)
TMobil	Indonesia (GSM), USA (GSM 1900), China (GSM), Philippines (GSM), Malaysia (GSM)
BT	India (GSM), Japan (PDC)
Telecom Finland	Hong Kong (DCS-1800), Lebanon (GSM), Turkey (GSM)
Telefonica Moviles	Venezuela, Argentina, Chile, Peru, Colombia, Brazil (all networks are AMPS-based)

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Among European operators, it is perhaps Deutsche Telekom that is the most active in promoting GSM in the Asia Pacific region, with investments in the mobile phone operations of:

- Isiacom in the Philippines,
- Celcomm in Malaysia,
- China (JV being formed).

Further, its subsidiary T-Mobile has taken stakes in:

- PT Satelindo in Indonesia, in which 25% stake for mobile phone and satellite services
- Technol. Ressources Industry Berhad (TRI) in Malaysia.

Deutsche Telekom is also the only European company really pushing for GSM to be adopted in Japan, as a different service compared with the one offered by Japanese operators that focus their marketing on terminals.

Indeed, also of importance is C&W 54% stake in Hong Kong Telekom, the market leader in mobile phone services, that offers GSM services. C&W and Hong Kong Telecom also jointly invested in Singapore's new operator Mobile One Asia (M1), along with Singapore Press Holding and Keppel Group, and the consortium is a bidder for new combined fixed / wireless service license that will run from 2000.

More recently, some European operators have started to back NTT DoCoMo's third generation cellular. Telecom Italia Mobile announced it would jointly work with NTT DoCoMo on making the Japanese system compatible with GSM, in a new format to be proposed on standardisation bodies.

In Latin America, Telefónica leads the field. Since the beginning of the 1990s, the Spanish operator has pursued an international expansion policy through its subsidiary TISA (Telefonica Internacional S.A.), set up specifically for this purpose and which now accounts for 16% of group turnover and more than 20% of its profits.

Other European operators are also showing interest in the Latin American market, especially STET France Télécom, and the special case of Cable & Wireless, which has been established for many years in the Caribbean region (Antigua, Trinidad and Tobago, Jamaica, Barbados, the Antilles) and in Colombia (a 22.3% holding in OCCEL) in the operation of mobile networks.

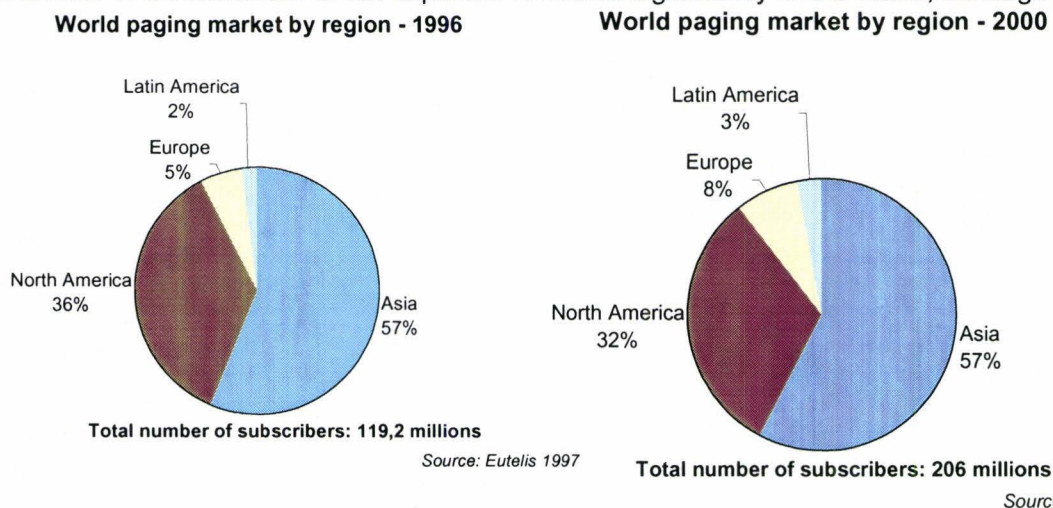


### 5.3. PAGING SERVICES

The market for paging services in general is expected to record a significant growth in the medium and longer term future. According to a study on the world paging market done by Eutelis, the paging subscriber base was 119.2 millions at the end of 1996. That number is expected to about double over the next 4 years until the end of 2000, to reach 206 million subscribers (or an annual average rate around 15%).

However in 1996 the market was very concentrated on few countries: 86% of the world's subscribers' base was five countries (USA, China, Japan, Taiwan and Korea), or 65% in two countries (USA, China).

Such a level of concentration is not expected to evolve significantly in the future, although Europe base



(5% in 1996) should triple to reach 16.3 million subscribers or 8% of the world's base in 2000. But at the same time, Asian countries should maintain their share around 57%, and then have 119 million subscribers in 2000.

But what will be the key market driver of such a growth in the coming years?

- **Competition:** in the fastest growing markets, competition between national operators has been the driving force behind paging growth.

the development of CPP (Calling Party Pays) offers and the arrival of competitors has increased sales in a very important proportion in many European countries but in France, the bulk of sales is still represented by the analogue network of France Télécom. In China, fierce competition between the 2000 paging operators has meant that subscriber figures have jumped from 16 to over 40 million between 1996 and 1997. In addition to this, mass marketing and public education of paging applications are critical to continued paging success, as well as being the primary growth driver for the future.

- **Competitive standards:** as paging services have to position themselves as a low end solution compared to cellular and PCS services, tariffs must be maintained well below cellular's ones. This requires to have very competitive costs, both at the infrastructure and terminal level, to keep profitability. Low costs can only be obtained from widely developed standards generating large volumes and decreasing production costs.

At the end of 1996, Flex had been adopted by 98 operators in 27 countries world-wide. Some European operators have shown their intention of using the FLEX technology

instead of ERMES (notably France Télécom and BT); For Osmo Hautanen, president of Philips Consumer Communications, FLEX has become a world de facto standard, and that has more impact on the decision than the technology aspects. With so many countries implementing the technology, there are going to be enough companies supplying infrastructure and terminal to allow all the network operators to build their businesses. For ERMES, as few companies are providing equipment (7 companies have terminal products available now), the availability of equipment is much more the issue than which technology is better than the other. If the map below shows that 30 countries already or are about to adopt the ERMES standard, currently, there are thirteen ERMES commercial paging networks operating in 9 European countries (including Eastern and Central ones), and three in the Middle-East (3 countries).

The Eutelis studies reported that 53% of European operators would select the Flex technology, versus 39% for ERMES.



- **Spectrum availability:** According to a recent study commissioned by the European Public Paging Association to KPMG, the two principles trends affecting future paging capacity will be increases in message volume and message length. The general move towards more data intensive, higher functionality applications such as email, will affect the channel capacity. Operators will first have to migrate to digital standards (Flex or ERMES) which are much more spectrally efficient than POCSAG. But in the longer term (2004), the spectrum shortage could become the major barrier to market development.

<b>Summary of opportunities and constraints for paging services</b>
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	<b>Opportunities</b>	<b>Constraints / Threats</b>
<b>Western Europe</b>	<ul style="list-style-type: none"> <li>• Market expected to triple within 4 years.</li> </ul>	<ul style="list-style-type: none"> <li>• About 50% of operators want to use the Flex technology.</li> <li>• Decreasing rates in several countries.</li> <li>• Competition from cellular networks.</li> </ul>
<b>Central and Eastern Europe</b>	- Few	Underdeveloped market
<b>North America</b>	<ul style="list-style-type: none"> <li>• Large and growing market for paging services.</li> </ul>	<ul style="list-style-type: none"> <li>• ERMES completely absent.</li> <li>• Market leadership of Flex for digital paging.</li> <li>• Competition from cellular networks.</li> <li>• Need for additional spectrum for new services.</li> </ul>
<b>Latin America</b>	<ul style="list-style-type: none"> <li>• Market to grow from 2.4 to more than 6 million subscribers.</li> </ul>	<ul style="list-style-type: none"> <li>• Small market</li> <li>• Very important US influence for standard choice.</li> </ul>
<b>Asia / Pacific</b>	<ul style="list-style-type: none"> <li>• World's largest market for paging services, expected to about double within 4 years.</li> </ul>	<ul style="list-style-type: none"> <li>• One country adopted ERMES.</li> <li>• Flex now considered as a de-facto standard in the region.</li> <li>• Competition from cellular networks.</li> <li>• Need for additional spectrum for new services.</li> </ul>
<b>Middle East / Africa</b>	Few	<ul style="list-style-type: none"> <li>• Underdeveloped market.</li> </ul>



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## 5.4. CORDLESS TELEPHONY AND WIRELESS LOCAL LOOP MARKETS

1997 has been a successful year for DECT. A large number of countries throughout the world have allocated frequencies for DECT, and operators installed both private and public systems. In 1997 alone the number of DECT units sold approached 10 million, exceeding the cumulated sales of previous years.

Until recently, DECT has been most widely used in applications in residential and business environments. Wireless local loop are emerging as another key area, with public access services based on DECT still in their infancy.

Europe was DECT's birthplace, but DECT is now sold on world-wide scale. According to Dataquest, the world annual market for DECT handsets for residential and in-building business applications is expected to grow from about 4 million units in 1997 to 13 millions in 2001.

### **DECT preferred technology for business applications**

From a market segment point of view, DECT is established as the preferred cordless technology for business applications with different product types serving different applications.

### **Strong potential in the residential and SOHO markets**

In the residential sector analogue cordless products still outsell DECT equivalents. At the end of 1996 in Western Europe, DECT accounted for 23% of the revenue generated by residential cordless telephones. That share reached 32% in 1997, and DECT is expected to become the leading technology of that market by the turn of the century. However the Western European market remains very concentrated as Germany represents 75% of the total market. In that country, 55% of residential cordless telephones sold in 1996 were DECT telephones. Most of other European countries are expected to follow that trend in the coming years. The Small Office/Home Office (SOHO) is another mass market where DECT has strong market potential.

### **DECT in public networks**

In the public networks arena, the DECT standard can support a number of applications such as Cordless Terminal Mobility (CTM) or Wireless Local Loop (WLL).

#### ***CTM***

CTM is a key area of interest for the DECT industry. In principle, CTM is capable of supporting all the telecommunications services that are available on the fixed network with significant mobility (although not comparable to what cellular systems offer). In Europe, Telecom Italia has been the first operator to invest heavily in a DECT based structure for public telephony services. However few months after having launched the service, it still doesn't seem to be very much of a success. Other European operators like Swedish Telia, decided not to go ahead after field tests of a DECT CTM solution.

#### ***Wireless Local Loop***

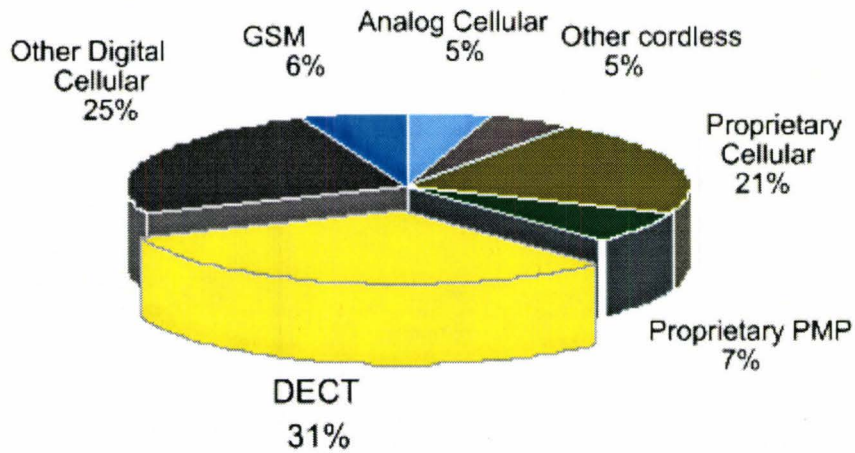
The use of DECT as a WLL application aroused considerable interest. ETSI has developed a specific profile to cover this application known as Radio Access Profile (RAP), incorporating both simple voice

telephony, ISDN support and packet data capability. Many operators have performed DECT WLL trials with satisfactory results. However what could be the actual market potential?

There is little doubt that the WLL market is on a roll. An average of a range of forecasts from different analysts, suggests that as many as 100 million wireless access lines will be installed by 2000 and by 2003 over half of all lines being installed world-wide will use wireless technology. Therefore the value of such a potential market is enormous.

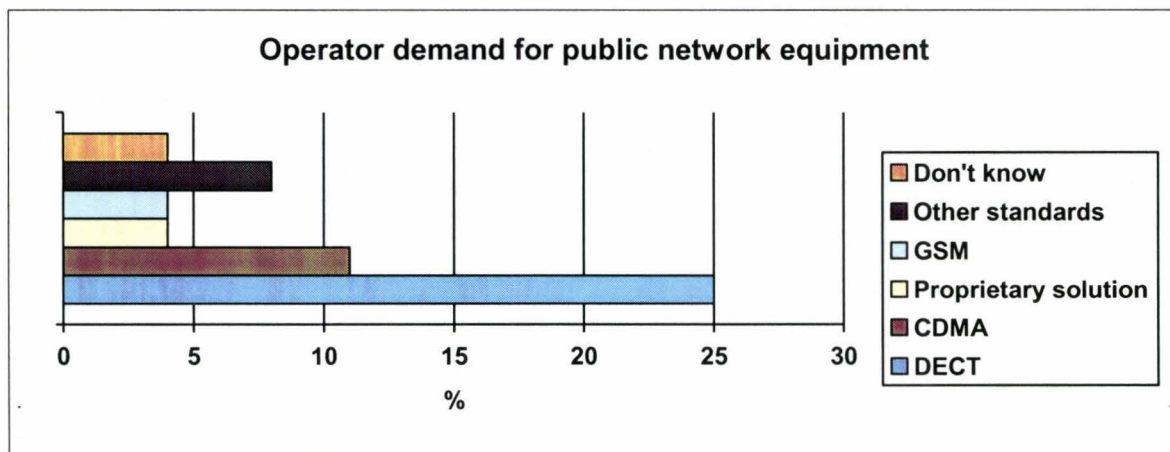
Within this sector, there is numerous technologies from a multitude of vendors competing. They range from proprietary systems such as Nortel's proximity, through cordless (DECT) to analogue and digital cellular (GSM, TACS, IS-95), and clearly show that if there is some form of agreement about market potential, there is less agreement about WLL technology.

### Technology breakdown: WLL Lines Awarded in 1997



Source: DECT Forum 1998

Most operators looking to implement WLL solutions are more concerned with the viability of the solution than the actual standard. Until recently, DECT was not seen as a serious contender because of concerns over range and cost. However this is changing and there are indications that DECT is emerging as a leader in global WLL market. According to Suresh Kandiyoor of Ericsson, DECT would have around 48% of the installed base of WLL systems world-wide. However according to a Dataquest study, of those available, DECT is the most favourite European WLL standard.





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*Source: Dataquest*

In addition to that, one major advantage DECT may have over competing technologies, is the fact that it is a standard and not a proprietary solution. This allow interoperability of different customer premises equipment

However, when looking more precisely at major world regions, the actual picture can widely vary.

**In the USA** there is no real future for WLL. Americans are very mobile and companies like ATT, Sprint, etc. have to pay as much as \$ 25 billion a year to local companies, only to use their local exchange networks (these local telephone companies are still subsidised to cover remote areas). So the trend is to by-pass these local exchange networks through a wide area mobile network and new operators find it easier and faster to focus on the PCS market.

**South East Asia and Latin America** represent the fastest growing markets for Wireless Local Loop systems. WLL networks are often used to replace the underdeveloped PSTN (Public Switched Telephone Network). In developed countries where the PSTN has achieved a high penetration rate, WLL systems are seen as a way to enter the local loop market for new entrants which do not have any fixed infrastructure. However, in such developing countries like China where the potential of WLL seems high, one has to keep in mind that the cost of installing a wired infrastructure is low, due to low manpower costs. As a result, although they would certainly have the advantage of faster installation, WLL systems really need to be cheap to be successfully marketed in such countries, which is not the case of DECT systems.

Among the biggest potential market for WLL is **China** which by the end of 1996, had a total of 54 million fixed telephone line, representing a penetration rate of only about 4.5%. As it has an ambitious plan of having a 12% penetration rate by the year 2000, China will therefore have to add 90 million lines, including new lines to the 400,000 or so villages that still do not have access to telephone services.

This means a huge market potential for Wireless Local Loop systems as well as cordless access systems. Since 1995 the MPT has been conducting a series of trials around the country, including with PHS and DECT systems.

For China Unicom, which has yet to deploy a fixed network infrastructure, WLL is especially important if it wants to increase its market share. The new operator is therefore reportedly trialing InterDigital Communications' B-CDMA system in the cities of Tianjin and Chengdu, with the financial backing of Samsung Electronics, a licensee of US-based InterDigital Communications'. Commercial outcome could be for next year.

Apart from a few experimental systems making use of different technologies and frequency bands that started to be deployed by NTT in 1996, Wireless Local Loop (WLL) for fixed network services is virtually non existent in Japan.

For PHS-based WLL, it is only earlier this year that NTT has confirmed its plans to experiment such WLL systems in remote regions such as Hokkaido. Such system should start being implemented in FY 1998, aiming at reducing the installation and maintenance costs to an estimated 1/5 to 1/10 of the cost of a wired infrastructure.

In **Latin America**, the potential market for WLL is huge due to the poor state of fixed networks, and very long waiting lists. However, in several countries of the region, frequencies are still not available. Brazil, Mexico, Peru Venezuela and Chile are delaying the actual availability of those frequencies in spite of the CITELE decision of September 1997.

**Eastern en Central Europe** is the region with the most sustained WLL activity to date. According to a recent Yankee Group study, the region (including CIS) has 67% of the developing world's WLL capacity. Hungary has the world's largest WLL implementation with 60,000 subscribers and 200,000 planned for 1998. Then greatest opportunities currently lies in countries where the transformation to market economies has started earliest: Poland, Czech Republic, Hungary, Slovenia and Slovakia.

Finally, in the **Middle East / Africa** region, although it has the lowest growth rate for WLL, some networks are up and running, and few countries already represent potentially good opportunities. They are, Zimbabwe, which has 20,000 WLL lines running, Namibia, or South Africa. By contrast there is currently very little WLL activity in the Middle East.

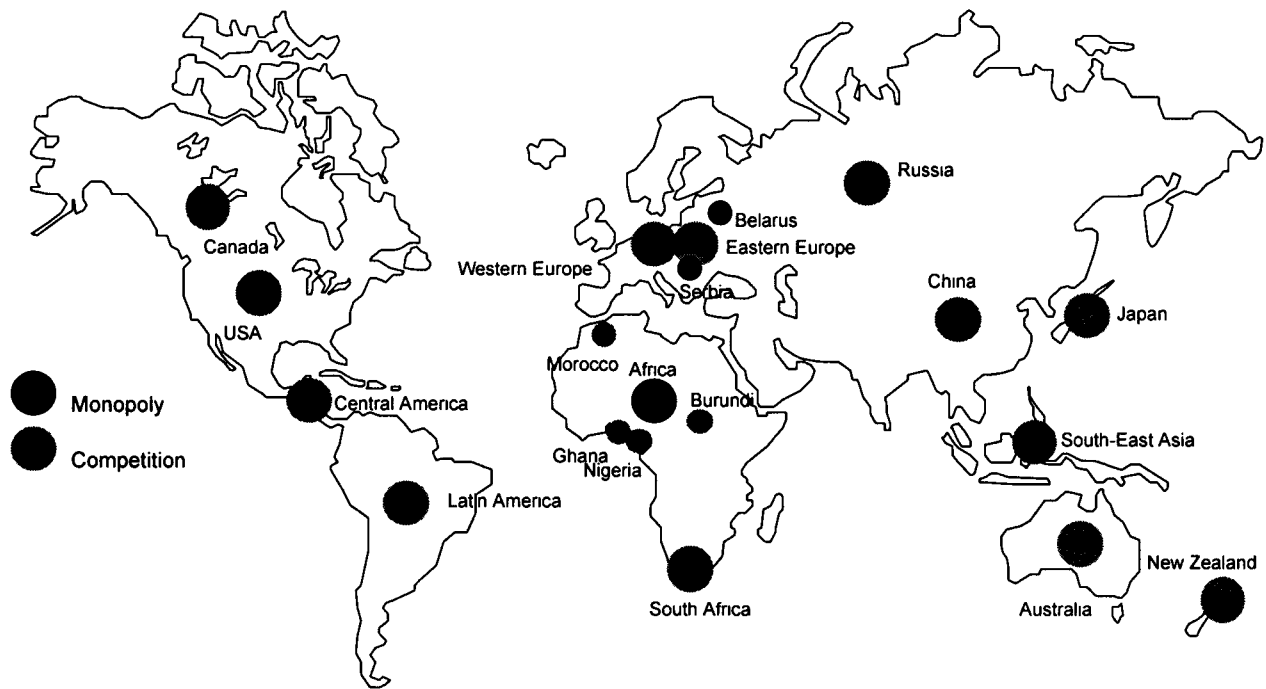
<b>Summary of opportunities and constraints for cordless and WLL</b>
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	<b>Opportunities</b>	<b>Constraints / Threats</b>
<b>Western Europe</b>	<ul style="list-style-type: none"> <li>• DECT most favourite European WLL standard.</li> <li>• Strong growth of DECT in the residential and business environment.</li> </ul>	<ul style="list-style-type: none"> <li>• Uncertainties DECT future in CTM (Italian experience).</li> </ul>
<b>Central and Eastern Europe</b>	<ul style="list-style-type: none"> <li>• Largest WLL capacity of developing countries.</li> <li>- Large opportunities in early adopter of market economy.</li> </ul>	<ul style="list-style-type: none"> <li>• Growing presence of non European technologies (notably CDMA).</li> </ul>
<b>North America</b>	<ul style="list-style-type: none"> <li>• Major opportunities may arise once several regulatory issues around local access, arising from the Telecom Reform Act, will be solved.</li> </ul>	<ul style="list-style-type: none"> <li>• No real future for WLL in the USA, as operators strategies are focused on PCS.</li> </ul>
<b>Latin America</b>	<ul style="list-style-type: none"> <li>• One of fastest growing market for WLL.</li> <li>• Lack of fixed infrastructures.</li> </ul>	<ul style="list-style-type: none"> <li>• Award of local loop licence often depends on local politics.</li> <li>• Spectrum availability remains a key problem (Brazil, Mexico, Peru, Venezuela, Chile).</li> <li>• Strong lobby from CDMA IS 95 N. American Companies.</li> </ul>
<b>Asia / Pacific</b>	<ul style="list-style-type: none"> <li>• Lack of fixed infrastructures and long waiting lists.</li> <li>• Growing per capita income in several countries. More people can afford a phone.</li> <li>• Rural part of Australia are poorly served with update telecoms infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>• Spectrum availability in India.</li> <li>• Too low per capita incomes in India and China.</li> <li>• Strong lobby from CDMA IS 95 N. American Companies, and from PHS (Thailand and Taiwan).</li> <li>• Perceived high price of Dect for WLL.</li> <li>• Limitation of direct investment.</li> </ul>
<b>Middle East / Africa</b>	<ul style="list-style-type: none"> <li>• Few countries implementing WLL such as Zimbabwe, South Africa Egypt or Namibia.</li> <li>• Poor or non existing fixed infrastructures.</li> </ul>	<ul style="list-style-type: none"> <li>• Lowest growth rate for WLL and cordless telephony.</li> <li>• Very little activity for WLL in the Middle East.</li> </ul>

### 5.5. EVOLUTION OF REGULATORY AND POLITICAL ENVIRONMENT

As shown on the following world map, countries in a monopoly situation are becoming more and more exceptional (in Africa and China). According to the WTO agreement recently signed by 69 countries, those barriers should be progressively removed over the next 10 years.

**Cellular radiotelephony regulatory situation**



Source IDATE "The world Atlas of Mobile" 1997

Political decisions and influence have been and continue to be of key importance in every world region. Historical and commercial relationships as well as geographical proximity can explain most of the regions' status today. However, from a telecommunications point of view in general, and mobile communications in particular, new supra national organisation and/or intention are currently being built in order to harmonise political, regulatory and technical choices for a given region. Understanding the role and objectives of those new organisations, will be essential to anticipate future evolution of mobile communication markets.

**Asia Pacific**

**The prospect of ATSI, an Asia-Pacific standardisation body**

Originated at a meeting of ministers of the United Nations Economic and Social Commission for Asia, which was held in New Delhi in 1996, the idea of an Asia-Pacific Telecommunications Standard Institute (ATSI) has been subsequently endorsed by the Asia-Pacific Telecommunity (APT). While the project is still in discussion, and although the ATSI would be expected to initially focus on such issues as equipment type approval, frequency co-ordination and mobile roaming services rather than developing new standards,

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supported by the region's fast growing market size, its establishment could in the longer term result in Asia-Pacific becoming a driving force in setting new standards.

### **The increasing driving role of Japan in the region**

As the weight of Asia is becoming more and more important in the global communication market, Japan has also been strengthening its position as the region's leader in the field of telecommunications.

Factors supporting this evolution include:

- the economic weight of Japan in the region, as Japan's GDP remains at a value 7 times higher than the 2nd biggest economy, China;
- the trend among Japanese manufacturers to increasingly invest and move production to lower labour cost neighbouring countries, which in turn results in closer relationships between Japanese companies and the local authorities;
- the recent deregulation on the Japanese market, that allows operators so far confined to the domestic market to start businesses on overseas market as well; this is notably resulting in NTT stepping up its overseas businesses in Asia, so far disguised under more limited ODA (Overseas Develop Aid) programs, and will allow the operator to invest in Asian operators;
- Japan's role in shaping a future ATSI;
- Japan's setting up of organisations like the PHS MoU Group, or the Asia Multimedia Forum, that involves Asian players, but where Japan keeps a leading role.

As a result, PHS has been starting to enjoy some success in the region, although the commercial outcome remains to be seen. The example of CDMA's adoption by several countries following Japan's decision to select these technologies shows that Japan can be a trend setter. Japan's determination to establish an international standard for 3rd generation cellular system could also be well received in the region.

Several interviewees have also stressed the importance of Japan for a European company, as a door to the other Asian markets.

## **Latin America**

Historically and culturally, Latin American countries have been close to Europe in general and Spain and Portugal in particular. From a commercial and economic point of view, the region is largely under the US influence for many years. In the future, the United States intend to extend the memberships of the NAFTA agreement, as well as put in place the FTAA (Free Trade Area of the Americas) by 2005, while at the same time, the European Union recently is expected to be in a position to sign a free-trade agreement with Mercosur as soon as 1999.

For instance, in the mobile communications arena all Latin American regulators adopted the FCC model of deregulation at the end of the 80s. In addition to that, geographical proximity to the USA of such a large country like Mexico favoured the adoption of American standards using the 800 MHz frequency band (AMPS) across the countries.

Most major Latin American countries are now moving towards the awards of PCS licences using digital systems. Although no specific systems has been imposed to new licensees, one significant competitive factor will be roaming capabilities. Nation-wide roaming is of the up-most importance, followed by roaming to contiguous countries and finally, international roaming. The latter two forms of roaming are less



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prevalent and of far less importance, **with the exception of roaming to the USA**. The reason for this is that Latin Americas nations are not as interdependent as, say, the nations of Europe. So far, trade agreement like the Andean Pact and Mercosur have had limited success in this respect. However, the North American Free Trade Agreement, which may be extended to several South American countries, is expected to have major impact regarding regional harmonisation of standards.

### **North America**

The political environment in North America is not expected to go through major change in the coming years. From an EU company perspective, it is much more important to look at where the United States want to extend their influence, especially in the Asia Pacific and Latin American regions and which barriers still exist.

On the latter item, three barriers still exist today:

- Although the market can be considered as widely opened, number of licences awarded remains restricted to two for each area.
- As the FCC awarded PCS licences for services partially using the IMT 2000 spectrum, questions on the availability of frequencies for 3<sup>rd</sup> generation systems remains unsolved.
- Canada still limit foreign equity of its telecom operators to 46.7%

### **Central and Eastern Europe**

With 10 countries having applied to join the European Union as soon as possible, a large part of that region is ready to adopt the EU model in general. It must be ensure that all EC directives will be completely implemented in each of these country, in order to ensure the future homogeneity of the market, once they joined the Union.

In the meantime, additional licences are expected to be granted in the coming years to increase competition and sustain market growth. In addition to that, market liberalisation is expected to further progress, as additional privatisations are already planned in most countries with national operator still under state control.

### **Middle East – Africa**

The pace of restructuring in the African telecommunication sector has been accelerating since 1990. Telecommunications is being separated from posts, telecommunication operators established as joint stock companies, regulatory agencies created and private participation in the cellular industry is growing.

The privatisation of public telecommunication operators and the introduction of competition in specific markets is also beginning to occur. As privatisation and liberalisation spread throughout the region, many complexities need to be resolved. Issues such as defining licensing terms, procedures and fees, interconnection agreements, universal service and tariffs policies must be addressed.

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One problem has been in the area of human resources: fears among telecommunication staff about possible displacement due to restructuring are delaying reforms. Another difficulty is financing the regulatory authority and ensuring its neutrality and independence. In general the new regulatory bodies in sub-Saharan Africa report to the relevant Ministry and are funded by licence fees. In Mauritius, the regulator reports to the Prime Minister and is funded by the government. The regulator is charged with most tasks, except the establishment of licence fees which is performed by the Ministry. In Nigeria, the regulator serves most functions, the only exception being frequency allocation which remains the responsibility of the Ministry.

The African Green Paper was inspired by the 1987 European Commission green Paper « Development of a common market for telecommunications services and equipment ». The Paper was prepared by a group of African experts and was adopted in May 1996. Although not being exhaustive, the following list highlights several decisions that must be taken at regional/subregional level:

- the establishment of a harmonising regime of licensing, declaration and authorisation which is transparent and non-discriminatory;
- the definition of tariff principles;
- the creation of consultative mechanisms by which the interests of all sector actors and users are taken into account in the definition of the rules and in the choice of main regulatory principles;
- the introduction of a certain number of procedures which are necessary to implement an efficient regulatory policy, particularly with regard to frequency management and type approval of terminal equipment;
- the creation of mechanisms for the harmonisation of technical standards;
- to promote the implementation and use, for inter-African communications, of pan-African telecommunication infrastructure;
- the definition of procedures for the resolution of disputes.

The introduction of regulated competition in the telecommunication sector implies the strongest role of the government as far as the policy, legal and regulatory aspects are concerned. An essential element in this process is the establishment, in the African countries, of a high level, multim ministerial Co-ordination Committee as agreed in Resolution ATDC-90/RES1 (Harare, 1990). This Co-ordination Committee, responsible for studying and proposing to the government appropriate national information and telecommunication policies covering the regulatory and operational aspects of the sector, seems to be the most appropriate national body for participating in the decision-making processes at regional/subregional level. The participation of representatives of the Co-ordination Committee in these processes will contribute to the creation of a harmonised multinational regulatory environment.

### ***5.5.1. Potential impact of international agreements***

On February 15th 1997, 69 countries signed a world-wide agreement to open their telecommunication markets. By allowing foreign firms to enter domestic markets, the WTO agreement is a major step in the direction of liberalising national telecommunication markets. However, its main shortcoming is that member countries are not obliged to apply most-favoured-nation treatment to all other members, and that commitment on national regulatory policies are rather vague. They are not detailed enough to make

competitive market access become a reality. In addition to that, WTO agreement are mainly targeting fixed line telecommunication services. Mobile, which in many countries is ahead of fixed services in terms of liberalisation, is not addressed specifically.

The WTO talks on telecoms arose from the Uruguay Round of the General Agreement on Tariffs and Trade (GATT). The trade disciplines of GATT can be distilled into 3 main areas:

- market access (i.e. opening markets in the first place)
- national treatment (foreigners having the same legal rights as indigenous companies)
- non-discrimination (the Most Favoured Nation or MFN principle).

Begun in 1986 and completed in 1993, the Uruguay Round extended these principles into the General Agreement on Trade in Services (GATS), which was incorporated under the WTO umbrella to address international trade in intangibles.

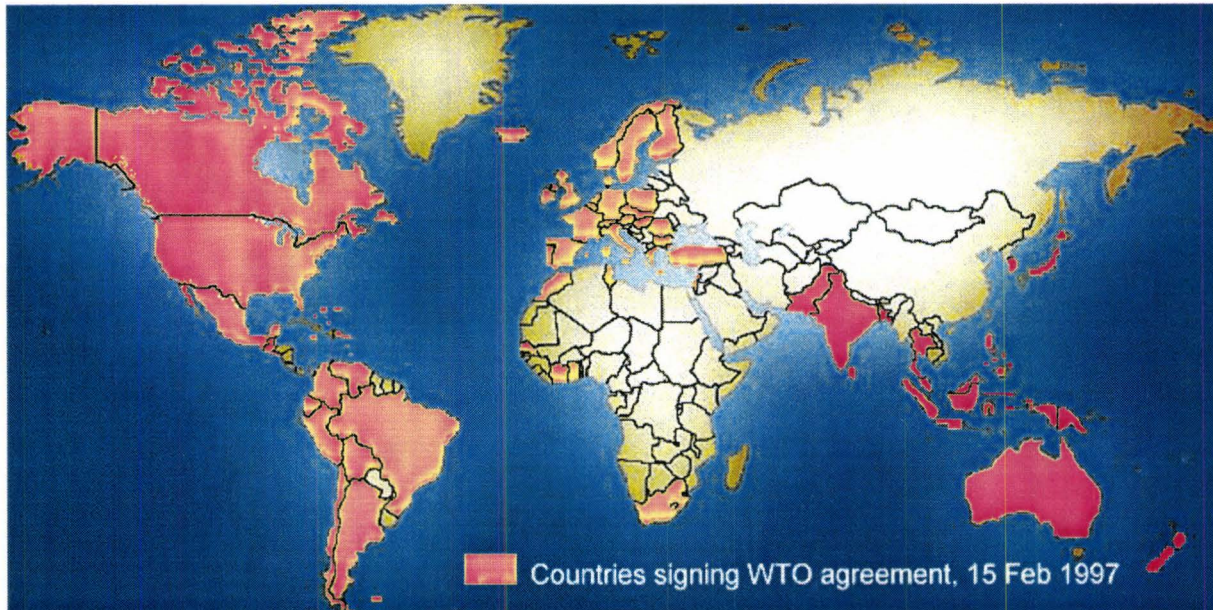
Although GATS was negotiated and implemented during the Uruguay Round, the 1993 talks on services ended with four issues left outstanding:

1. telecom
2. natural movement of people
3. maritime services
4. financial services

Telecom talks in particular were assigned to the Negotiations Group on Basic Telecommunications (NGBT) which started in May 1994 with an April 1996 deadline. Some 48 governments representing over 90% of the global telecom revenue joined the negotiations.

For many of the 69 countries who are party to the mid-February agreement, the exercise of making a commitment allowed them to review the current status of their telecommunications and to plan opening of this sector over a period of several years.

However, not all countries will liberalise at the same pace. Many countries have made phased commitments in accordance with the current situation in their telecommunications sectors. In addition to that, a detailed review of the countries' commitment shows that in most cases, there is a lack of clear definitions as to which telecommunications services have been committed to liberalisation and which have not.



### **Potential impact on mobile communications markets**

On the medium to long term, it makes no doubt that WTO telecom agreements, once they will be fully implemented by all members, will have major impact on the evolution of the telecommunication services industry. On the other hand, the overall advanced status of mobile communications in terms of liberalisation, and the fact that no specific details were provided for mobile communications mean that additional work is required to take into consideration issues specifically related to radiocommunications notably such as frequency allocation.

The mobile industry being widely open for several years everywhere in the world, in the short term, WTO agreements will mainly strengthen that trend, opening markets to more competition, especially where monopoly is still dominant, for both operators and equipment manufacturers, which often stimulate market growth.

The analysis of countries' engagement for mobile communication services and equipment clearly shows two main aspects of the agreement:

- On the services side, numerous countries are imposing limits to the presence of foreign companies into national operator's capital. In most cases those limits are for direct and indirect investments and/or for a number of years to come. The US, which initially announced a 25% limit for foreign ownership, finally modify their position at the end of 1997, allowing up to 49% direct or 100% indirect foreign ownership.
- On the equipment side, no specific details are provided within the agreement regarding potential limitations.

### **Potential barriers for EU companies:**

- **the actual implementation of the countries' engagement is not mandatory.** A detailed monitoring of how regulatory regimes are evolving towards the full implementation of the agreement becomes critical, to identify region or country where specific actions are required. In addition to that, most of the developing countries do not have neither the resources, nor the

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expertise to properly manage the evolution of their country's telecommunications industry towards more liberalisation. Some impartial support is required at this level.

- **Mobile communications were not a major part of the agreement:** therefore issues around spectrum allocations have not been addressed. On the other hand, the overall negotiations taking place within at the World Radio Conference, will need to take into consideration the consequence of the agreement, and notably ensure that decisions about spectrum, cannot be perceived by some, as a means to limit market access.
- China has one of world's largest market potential for cellular telecommunications and paging. But **China is not a WTO member**, and then did not sign the agreements, therefore reducing the official solution to have that country moving towards more liberalisation.



<b>Opportunities and constraints from regulation and political environment</b>
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Opportunities and constraints related to the regulatory and political environment have been summarised in the following table.

	<b>Opportunities</b>	<b>Constraints/threats</b>
<b>Western Europe</b>	<ul style="list-style-type: none"> <li>• Harmonisation of countries' regulatory regimes for 3<sup>rd</sup> generation.</li> </ul>	<ul style="list-style-type: none"> <li>• The short term need for a well defined and homogeneous regulatory regime for UMTS.</li> <li>• The actual set-up of a large and strong 'home' market.</li> </ul>
<b>Central and Eastern Europe</b>	<ul style="list-style-type: none"> <li>• Application of 10 countries to join EU.</li> </ul>	<ul style="list-style-type: none"> <li>• Possible delays in market liberalisation.</li> <li>• Need for regulatory and technical homogeneity (terminal type approval).</li> </ul>
<b>North America</b>	<ul style="list-style-type: none"> <li>• Full liberalisation of the market.</li> </ul>	<ul style="list-style-type: none"> <li>• The availability of frequencies for 3<sup>rd</sup> generation systems.</li> <li>• Political lobbying with WTO signatory countries.</li> </ul>
<b>Latin America</b>	<ul style="list-style-type: none"> <li>• Numerous licences to be awarded across the region, notably for PCS services.</li> <li>• Limited success of regional trade agreements.</li> <li>• Development of trade relations between Mercosur and EU.</li> </ul>	<ul style="list-style-type: none"> <li>• The actual implementation of FTAA and NAFTA agreements</li> <li>• Wide US political and financial influence across the region.</li> <li>• The actual implementation of WTO agreements.</li> </ul>
<b>Asia Pacific</b>	<ul style="list-style-type: none"> <li>• The creation of a regional standardisation body (ATSI).</li> <li>• Fast move towards market liberalisation and deregulation.</li> </ul>	<ul style="list-style-type: none"> <li>• The increasing driving role of Japan in the region</li> <li>• The Chinese situation vs. WTO.</li> <li>• The actual implementation of WTO agreements.</li> </ul>
<b>Middle East / Africa</b>	<ul style="list-style-type: none"> <li>• The actual implementation of the African Green Paper.</li> <li>• Privatisation and liberalisation spread throughout the region.</li> </ul>	<ul style="list-style-type: none"> <li>• Most regulators remains under government control.</li> <li>• The actual speed of implementing reforms.</li> </ul>

