Work Package:	**6**
Activities:	**6.5**
Type of document:	**Report**
Date:	20.12.2007

IST Integrated Project No 026920

Partners: Eutelis Italia
CELG
Elektro Ljubljana

Responsible: Eutelis Italia

Circulation:
l **Public**
☐ **Confidential**
☐ **Restricted**

WORLDWIDE MARKET RESEARCH REPORT

Document History

Vers.	Issue Date	Content and changes
0.0	24.03.04	Template
0.28	04.12.07	TC review
0.30	14.12.07	After TC review for SC review
1.0	20.12.07	Released

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GLOSSARY AND ACRONYMS

ACMA	Australian Communications and Media Authority
ADSL	Asymmetric Digital Subscriber Line
AM	Amplitude Modulation
AMI	Advanced Metering Infrastructure
AMR	Automatic Meter Reading
ARPU	Average Revenue Per User
ARRL	American Radio Relay League
ATM	Automatic Teller Machine
BPL	Broadband over Power Line
bps	bit per second
BWA	Broadband Wireless Access
CAGR	Compound Annual Growth Rate
CATV	Community Antenna Television
CCTV	Closed Circuit Television
CDMA	Code Division Multiple Access
CEE	European Economic Community
CIS	Commonwealth of Independent States
CISPR	International Special Committee on Radio Interference
CPE	Customer Premises Equipment
CTMM	City of Tshwane Metropolitan Municipality
DAS	Distribution Automation System
DES	Data Encryption Standard
DHCP	Dynamic Host Configuration Protocol
DPL	Digitised Power Line
DRC	Democratic Republic of Congo
DRM	Digital Rights Management
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer

DSLM	Demand Side Load Management
DSM	Demand Side Management
DTMF	Dual-Tone Multi-Frequency
DTV	Delivered cable Television
DTTV	Digital Terrestrial Television
DVB	Digital Video Broadcast
EDGE	GSM Evolution
EMEA	Europe, Middle East and Africa
ETSI	European Telecommunications Standards Institute
EU	European Union
FBWA	Fixed Broadband Wireless Access
FCC	Federal Communications Commission
FDD	Frequency Division Duplex
FEPTRI	Fujian Electric Power Testing and Research Institute
FTP	File Transfer Protocol
FTTB	Fiber To The Building
FTTH	Fiber To The Home
GDP	Gross Domestic Product
GSM	Global System for Mobile communication
HD	High Definition
HDTV	High Definition Television
HE	Head End
HF	High Frequency
HFC	Hybrid Fibre-Coaxial
HK$	Hong Kong Dollar
HSDPA	High Speed Downlink Packet Access
HSDN	Homeland Secure Data Network
HSIA	High-Speed Internet Access
HTTP	HyperText Transfer Protocol
IAD	Internet Access Device

ICASA	Independent Communications Authority
ICT	Information and Communication Technologies
IDA	Info-Communications Development Authority
IDS	Intelligent Distribution System
iDTV	interactive Television Services
IEEE	Institute of Electrical and Electronics Engineers
IMF	International Monetary Fund
IP	Internet Protocol
IPC	Consumption Potential Index
IPTV	Internet Protocol Television
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
IT	Information Technology
ITU	International Telecommunication Union
IT&C	Information and Communication Technologies
KEPCO	Korea Electric Power Company
KEPRI	Korea Electric Power Research Institute
LV	Low voltage
LAN	Local Area Network
MAC	Media Access Control
MAN	Metropolitan Area Networks
MB	Mega Byte
MCIT	Ministry of Communications and Information Technology
MDG	Millenium Development Goals
MDU	Multiple Dwelling Unit
MIC	Ministry of Internal Affairs and Communications
MOCIE	Ministry of Commerce, Industry and Energy
MPLS	Multi-Protocol Label Switching
MV	Medium Voltage
MVNO	Mobile Virtual Network Operators

NATO	North Atlantic Treaty Organization
NICI	National Information and Communication Infrastructure
NGN	Next Generation Networking
OECD	Organisation for Economic Co-operation and Development
OFDM	Orthogonal Frequency-Division Multiplexing
OPERA	Open PLC European Research Alliance
OSS	Open Source Software
OVLAN	Optical Virtual Local Area Network
PC	Personal Computer
PDA	Personal Digital Assistant
PLC	Power Line Communications
POP	Post Office Protocol
POTS	Plain Old Telephone System
PQM	Power Quality Monitoring
PSTN	Public Switched Telephone Network
PTN	Public Telephone Network
PTO	Posts and Telecommunications Office
PUA	Universal Powerline Association
PVR	Personal Video Recorder
QoS	Quality of Service
R	RAN
RD	Radio
RF	Radio Frequency
ROE	Rest Of Europe
SCADA	Supervisory Control And Data Acquisition
SME	Small and Medium Enterprise
SMS	Short Message Service
SNMP	Simple Network Management Protocol
SNO	Second National Operator
SoHo	Small Office and Home Office

TBD	To Be Defined
TCP	Transmission Control Protocol
TDD	Time Division Duplex
Tepkco	Tokyo Electric Power Company
TFTP	Trivial File Transfer Protocol
Triple Play	Broadband services including: Internet, VoIP and IP-TV
TV	Television
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunications System
UN	United Nations
UNECA	Nations Economic Commission for Africa
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UPA	Universal Powerline Association
UPDEA	Union des Producteurs et Distributeurs d'Energie Electrique d'Afrique
UPLC	United Power Line Council
URD	Underground Residential Distribution
US	United States
USD	United States Dollar
USB	Universal Serial Bus
VANS	Value-Added Network Service
VCR	Video Cassette Recording
VDSL	Very high bitrate Digital Subscriber Line
VHSL	Very High speed Digital Subscriber Line
VLAN	Virtual Local Area Network
VPN	Virtual Private Networks
VoD	Video on Demand
VoIP	Voice over Internet Protocol
VSAT	Very Small Aperture Terminal
Wi-Fi	Wireless Fidelity
Wi-MAX	Worldwide Interoperability for Microwave Access

WLAN	Wireless Local Area Network
WP	Work Package
WTO	World Trade Organisation

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1 PURPOSE

The purpose of this report is twofold: (1) to provide an update of PLC activity in Western Europe in terms of the penetration of services offered; the services being those identified in OPERA I, and (2) to provide an overview of PLC developments outside of Western Europe. The regions reviewed are Eastern Europe, Asia, the Americas and Africa.

2 INTRODUCTION

Since the inception of the OPERA project by the EU, most attention has been focused on PLC development in Europe. As the focus on most of the early significant PLC developments was on Austria, France, Germany, Italy, Spain, UK, a knowledge gap regarding the PLC developments in the rest of the world became apparent, had to be closed.

Before proceeding to the rest of the world, OPERA II was asked to determine to what extent PLC-based services identified in OPERA I had been introduced into the Western European markets. This review of the experience gained to date (since the conclusion of OPERA I) was required as it might impact the development of a modified Business Plan (D32-Amendments and Revisions to the Business Plan) in OPERA Phase II. As such, a survey of the services was produced for the D32 Business Plan report, which was submitted on June 30, 2007. This section is again reproduced in this report, see section 4.

The remaining sections of this report address the development in Eastern Europe, Asia, Africa and the Americas. The size of these regions/countries to be reviewed, the different regulatory environments for electric power utilities (on both country and state level), the varying quality and volume of infrastructures, differing focus on PLC applications and varying stages of preoccupation with the subject of PLC mandated differing approaches in describing the PLC activities in these heterogeneous regions. Similar as for the Western European services survey, response to information requests for specific PLC experience in the above named regions/countries was modest at best. Different information sources had thus be used.

The following approaches were used:

- Eastern Europe: Internet research
- Africa: combination actual projects and Internet research
- Asia: individual major country-level projects
- South America: major utility experience
- USA: focus on the regulatory progress

This is a research report. Therefore the report is very long, particularly the sections on Africa and Eastern Europe. As relatively little concrete and complete information could be obtained and PLC activity varies from region to region, statistics on the power utility industries, the IT/ telecommunication industries and services, as well as a discussion of the regulatory and policy environments have been included in some depth for some regions. This statistical research material may be of interest to those companies venturing into "underdeveloped" PLC regions – and thus serves to provide an overview of those environments in which PLC holds most promise.

"This report does not purport to contain the most correct and up-to-date information, as the research material stems from a number of external sources. Therefore the authors of this report cannot be held responsible for the complete correctness and up-to-dateness of the information provided. Greatest care was exercised in identifying and using the latest information."

3 EXECUTIVE SUMMARY

There is significant PLC development activity in the technical and application areas throughout the world. The development status and focus for the use of PLC differs somewhat from region to region today.

In **Western Europe**, the early impetus and focus on the use of PLC to bridge the last mile has lost momentum – due to the rapid growth and good penetration of alternative broadband technologies, such as DSL and wireless technologies (e.g. WiMax) – including some Eastern European countries). PLC opportunities for broadband access continue to exist in niche markets, in which the former incumbent PTT and privately owned competitive broadband providers have not been active due to financial reasons. As FTTH becomes significantly less expensive, FTTH is emerging as another major broadband access technology. The future focus for PLC in Europe lies in the smart grid applications for power utilities and for in-house use, e.g. LAN, Triple Play, which have already found their way into European homes.

The **Eastern European** region may be divided into the 1990's war-torn zone (South Eastern Europe) and the former communist states which were not directly affected by the destructive nature of war. In the latter, and since their admission to the EU, citizens in most urban areas have a number of choices for telecommunication services (fixed and mobile networks). In the remote urban areas, and in those countries in which enemy action destroyed electrical and telecommunication infrastructures, the need for the build-up of basic infrastructure is high and is proceeding, yet slowly – also due to the difficult terrain. In these regions there is little PLC activity today. PLC applications will develop as the electrical grids are restructured and as the needed PLC-based network services will not be met by traditional technologies.

In **Asia**, significant development of the PLC technology continues. In Japan, where the regulator has not allowed PLC for use in the access area, PLC is partnering with FTTH suppliers to provide the in-house LAN. In China, a similar development FTTH/PLC is taking place. In Korea, an integrated PLC technology has been developed to satisfy the demand for both the electric utility (smart grid applications) and the home (intelligent home applications and triple play provision). PLC is also used in the access area, but volume rollout for the masses is achieved today through DSL and wireless technologies.

There exist only few PLC installations in **Africa**. Most of these are found in South Africa, the pioneer of PLC In Africa. The lack of sufficiently broad electricity networks in many African nations presents relatively little opportunity for PLC to reach a majority of Africa's citizens. Here also, wireless technologies appear to bear most opportunity.

The PLC focus in the **USA** has been for some years in home networking, for which equipment standards have been developed. More recently, activity to develop standards also for PLC equipment for the access area has accelerated, and is well under way. Additionally, owing to the slow modernisation of state controlled electricity networks, PLC has been demonstrated as the most viable and affordable technology to manage and optimize electricity networks. PLC-based smart grid applications show significant progress in financing and proliferation in the USA.

South America has seen a number of PLC pilot projects for both the access and the home areas. The major countries Brazil and Argentina have well developed electricity networks, coupled with a high demand of broadband access for the population. Additionally, these well developed electricity networks offer a significant opportunity for smart grid applications.

[AU1] No review of worldwide PLC activity would be complete without mention of **Australian** telecommunication infrastructures. Since about 2006, a number of utilities have ventured into telecommunications, among these are, PowerTel, Uecom and Transact. Utilitel is an informal forum of electric power utilities with a common interest to comercialize their telecommunication activities. Key players in this forum are Silk Telecom, Aurora (others are Country Energy, Nexium, Transgrid).

[AU2] In a conference of the spring of 2007, (3rd Power Line Communications Asia, March 8, 2007) Aurora Energy, the state-owned electricity provider of the island of Tasmania presented its PLC project. In a commercial trial of 2005 (with 300 commercial subscribers, 1200 homes passed) the PLC technology confirmed its use as an access method for broadband and for in-house use. In this particular case, the environmental conditions for

PLC were very favorable; a 50% Internet user community (of which 60% was on dial-up), poor DSL coverage, low affordability rating and monopoly-based prices for access. Aurora Energy is therefore pursuing PLC for the provision of telecommunication services, as well as for the subsequent use in smart grid applications.

On the Australian continent, a company called Silk (formed from the South Australian Utility ESTA and Powercor) was created in 2006, which owns the fiber resources of the above utility companies. Based on the successful model of Aurora, and its mother company experience (Cheung Kong, Hong Kon) Silk announced in March that it would undertake several PLC pilot projects in Melbourne and Victoria.

Despite the fact that the ACMA (Australian Communications and Media Authority) has created an environment for PLC pilot projects, full commercial introduction is still dependent on the availability of radio emission guidelines and equipment standards. Through their ownership of fiber networks, and concrete entry into the telecommunications market, it is expected that electric utilities will expand their PLC applications portfolios significantly once the above are resolved.

4 SERVICES PENETRATION – Western Europe

4.1 Background

During the Phase I of the OPERA project, which was carried out over the 2 year period 2004-2005, WP4 (Services) identified a number of services the delivery or transport of which would be suitable over PLC access networks.

As a follow-up to OPERA I, WP6 was asked to provide an overview of the penetration of the latter PLC-based services in Europe.

4.2 OPERA I Services

Most of these services were services which heretofore had been classified as telecommunication services or had been provided via telecommunication links. The remainder were services for applications in areas such as AMR, telesurveillance etc. The following services from OPERA I were considered.

- Internet Access
- Telesurveillance
- AMR
- VoIP
- E-Health
- Smart Homes
- Video on Demand
- SME
- Telecommunication Services

4.3 Survey

4.3.1 Survey Methodology

The primary intention of the survey was to determine which services are provided commercially and what future developments in the type of services may be expected from these PLC providers.

For the purpose of the PLC services survey, a questionnaire was created and mailed to 17 service providers throughout Europe. (The development in the PLC-based services in the rest of the world will be treated in D37 World Wide Market Research). The companies contacted were known to be active PLC providers since at least 2004. Additionally, a number of PLC equipment suppliers (e.g. Ilevo, Mainnet, DS2), as well as a number of other PLC market associated groups (e.g. PUA, Universal Powerline Association, industry contacts) were contacted to increase the survey sample and to provide input on various PLC associated developments.

Information was obtained from eleven out of 17 contacted and researched providers, representing 6 different European countries (Austria, Germany, Italy, Portugal, Spain, Switzerland). The information received contained the types of services offered, number of subscribers, growth estimates etc. The survey basic results are reflected in Table below.

4.3.2 Survey Findings

The Table 4-1 below shows the responses to the survey. It only contains those services which were identified and are being offered by the responding PLC service providers.

Provider	No. Of Subscribers	Internet Access			Telesurveillance			AMR			VOIP			Smart Home		
		% Subs.	% Value	Growth	% Subs.	% Value	Growth	% Subs.	% Value	Growth	% Subs.	% Value	Growth	% Subs.	% Value	Growth
1	200	100	100													
2	5500	100	100	70						~60000						~200
3	14500	95	80		1	10		4	10							
4	3500	100	100													
5	400	100	100					3	0		100	100				
6	**(1)**	100	100													
7	**(1)**	100	100													
8	**(1)**	100	100													
9	130	100			5		10	70		300	30		100	5		10
10	1000	90		100		5	10			10	15	15	50	5		10
11	2500	**(2)**														

(1) *Subscribers included in Provider 3 number*

(2) *Test Phase only*

Table 4-1 Services offered by PLC providers

Findings of the survey:

- Internet Access is offered by all PLC providers, and appears to be the major revenue generator

- AMR is provided by 3 providers, and planned by another two providers
- Telephony ("VoIP") is offered by 3 providers, with a 4th testing VoIP. Only 2 providers project a growth of their telephony business
- Both telesurveillance and Smart Homes applications are offered by 2 providers, both of whom predict future growth for their companies
- Two service providers own 47% of the total subscriber base (total of 27730 subscribers reported)
- The number of subscribers per provider varies significantly (from 130 to > 15.000)
- Austrian and German providers together reported the largest concentration of PLC subscribers (73%)
- The most frequently identified future growth candidates for PLC applications are AMR and Smart Homes

4.4 Implications of the Survey

While the survey sample was relatively small, one can nonetheless recognize some trends regarding future services to be provided over PLC infrastructures:

- the previously heralded VoIP application has not fulfilled its promise. Initially it was held that the combination of Internet access and telephony would result in a positive business case. However the strong decline of the price for telephony, coupled with the complexity and integration cost of the telephony service have shied away most PLC service providers. In the meantime, such developments as "true" VoIP, using laptops, PCs, and PDAs, the significant growth of pre-selection numbers and services (e.g. Skype) have reduced the telephone call to a commodity service.(see also Chapter 5, Use Cases).
- Most PLC providers still are relatively small operations, having only partially penetrated their total available markets in Western European countries. This could

imply that PLC operators will continue to lead a "niche life", at least in those regions which participated in the survey.

- Most new growth opportunities were identified in the areas of AMR, and Smart Homes applications. This appears to be the focus for the surveyed providers.

As a result of the above findings, and the parallel trend of the electricity industry's preoccupation with the improvement and securing of their electricity grids, the WP6.1 team agreed to modify the business plan with an AMR application.

4.5 Development of competitive technologies

The PLC competitive broadband technologies had been described previously in the OPERA I phase. For the purpose of this report, the following competitive technologies will be briefly reviewed from their growth and penetration point of view. It will thus become evident that the penetration rates of these technologies have been higher than the adoption of PLC based services.

4.5.1 Broadband cable

4.5.1.1 Description

A data cable service is delivered to a subscriber through channels in a coaxial cable or optical fiber cable to a cable modem installed externally or internally to a subscriber's computer or television set.
Cable broadband services - generally referred as **fiber cable** - are based on a hybrid fiber / coaxial cable (HFC) configuration in which a fiber cable carries network traffic to a remote node and then on to a coaxial cable bus that connects to individual subscribers.
Download transmission operates in a broadcast mode at rates as high as 5 megabits per second. Slower upload transmission is shared between users in a manner similar to DSL.
As far as the TV services are concerned - i.e. Community Antenna Television or Cable Television (**CATV**) -, cable broadband is a comparable offering, utilizing existing TV cable

lines instead of existing phone lines as with DSL. A part of TV cable infrastructure relies partly on fiber optic lines; however, the bulk of wiring and the "last mile" wire in particular, is still a coaxial cable which carries cable television to people's homes.

Beyond its traditional role of delivering analogue and digital TV, cable networks can provide new services to the customers. High Definition Television (HDTV) is making its entry, different packages are being created and interactive television services (iDTV) are gaining popularity. Besides TV, broadband internet is a part of the key business of cable operators. Voice over IP and other multimedia IP services based on reliable and guaranteed quality of service are being placed on the market by cable operators all over Europe, allowing customers to chose new and innovative products such as gaming, video conferencing etc.

Fiber optical transmission has the greatest potential for bandwidth expansion. One fiber strand has the potential for a data rate of 40 gigabits per second, or a thousand times that of most other alternatives which are usually quoted in megabits per second. Using a technique called wavelength division multiplexing in which 100 different colors of light can transmit simultaneously on the same fiber strand, transmission rates as high as 4 terabits per second can be achieved.

4.5.1.2 Present Situation and Growth

Today cable operators have more than 60 millions of subscribers in Europe.

The present situation of Western European market share for cable revenue services is split among:

- 18% telephony (Voice over IP, IP video telephony)
- 22% internet (High speed internet connection)
- 60% TV services (Broadcasting Program distribution, Video on Demand)

Cable plays an important role in driving innovation in broadband and has accelerated roll-out of high speed networks by the telecom incumbents. Moreover, in those European markets, where cable has been allowed to reach considerable scale through consolidation, broadband penetration is significantly higher than in countries where cable is still relatively fragmented.

The development of ubiquitous, broadband cable television systems affords an opportunity to see the rapid realization of extremely powerful digital networks. The HFC network offers an excellent high-speed data network solution and combines that with a high degree of scalability to adapt to new technologies or services, that may be introduced in the future. The key to the provision of all of this capacity is the ability to increase the penetration of optical distribution equipment as the need arises.

The following figure (source CRU Wire & Cable group) shows the fiber cable market - transmission equipment, cable, and apparatus - with some of the main countries in Europe (France, Germany, Italy, Spain, and the U.K. are grouped together as "the Big Five"), by key country groups, 2004-2010, (in $ Millions and Percent of Total).

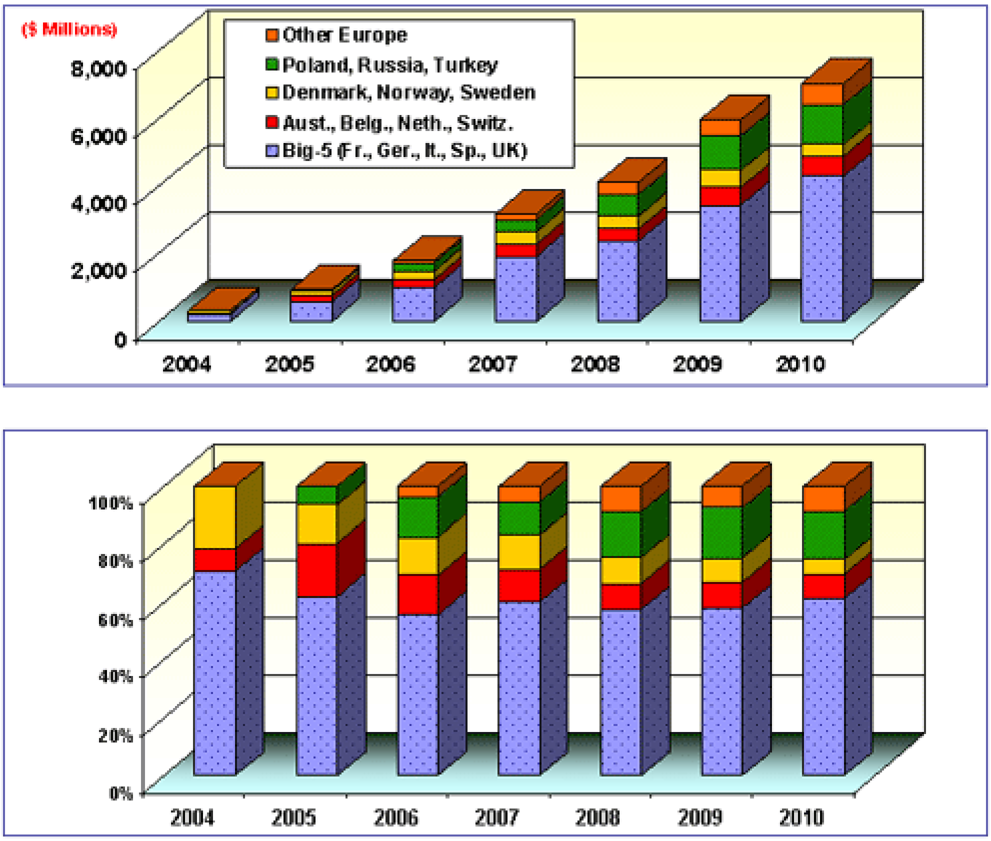


Figure 4-1 Fiber cable market 2004-2010

Moreover, the following figure (source EITO Observatory 2007) shows, specifically for CATV market, the present and expected value of services in EU.

The EITO numbers show a low trend of penetration of CATV applications in the Western European nations and a higher growth in the Eastern European nations (ROE = rest of Europe Nations).

CATV Services	2005	2006	2007	2008	2006	2007	2008
	VALUE (Million €)				GROWTH (%)		
Europe CATV	15.450	15.858	16.208	16.497	2,6	2,2	1,8
Europe 15 + Norway, Switzerland	14.141	14.409	14.614	14.742	1,9	1,4	0,9
ROE CATV	1.309	1.449	1.594	1.755	10,7	10,0	10,1
Total Europe Carrier Services	293.414	299.899	303.985	307.027	2,2	1,4	1,0
Europe 15 + Norway, Switzerland Carrier Services	271.993	276.537	278.970	280.622	1,7	0,9	0,6
ROE Carrier Services	21.421	23.362	25.015	26.405	9,1	7,1	5,6
Europe CATV as a % of Total EuropeCarrier Services	5,3	5,3	5,3	5,4			
ROE CATV as a % of ROE Carrier Services	6,1	6,2	6,4	6,6			

(Source: EITO Observatory 2007)

Table 4-2 CATV market 2005-2008

4.5.2 xDSL

4.5.2.1 Description

Digital subscriber lines (DSL) represent a technology designed to extend the capabilities of the traditional twisted pair of copper wires connecting telephone subscribers to a central office for high speed data transmission. DSL service is provided down the regular copper lines which connect to the telephone. Twisted pair wires are inherently narrow in bandwidth, but innovations in advanced digital signal processing have made it possible to extend the data rates significantly from the previous 56 kilobits per second of an ordinary telephone line into a channel with rates in one direction as high as 6 megabits/second.

Asymmetric Digital Subscriber Line (ADSL) is a form of DSL which can provide a maximum download speed of 8 megabits per second and a maximum upload speed of 800 kilobits per second.

ADSL2 and ADSL2+ reflect an improvement of the ADSL technology, improving broadband performance by dramatically enhancing bandwidth. Increased bandwidth allows data transfer at speeds of up to 24 megabits per second for ADSL2+ and up to 12 megabits per second for ADSL2 services.

A more advanced form of DSL, very high speed digital subscriber line (VHSL), is capable of transmission speeds up to 26 megabits per second in the download direction.

The figures above are theoretical as there are many factors which determine the real download speed: the length of the copper wire from the telephone exchange to the premises, the number and type of other services being used over the copper wires, electrical interference from outside sources, copper wiring within the premises, etc. Due to these factors, the actual speed you receive on your service can vary from the maximum stated speed to values even ten time lesser.

The principal limitation of ADSL is its asymmetry in which download data rates are much faster than upload data rates. For many applications, this imbalance is not that important, but for others such as video conferencing, balanced symmetric data rates are critical. Other limitations of DSL relate to its reduced performance in older neighborhood installations where line quality may be poor. It also has an upper limit on data rate capability which is inferior to other technologies such as fiber to the home.

4.5.2.2 Present situation and growth in comparison to cable modem

Worldwide penetration of DSL is twice as high as for the cable modem. Since incumbents generally dominate DSL services, this strong position for DSL represents a challenge in terms of competition policy.

The Table 4.3. below shows the penetration rates and growth rates of the most prevalent broadband access technologies (Source: EU “E-Communications Household Survey 4/2007”).

	Average EU 27 households	Average EU 25 households	% change EU 25 Winter 2007 / Winter 2006
Broadband internet access	28%	29%	+6%
DSL access	22%	23%	+4%
Cable-modem access	6%	6%	+2%

Table 4-3 DSL / Cable Modem Access Growth

The next figure shows the situation of broadcast subscribers for DSL and cable technologies.

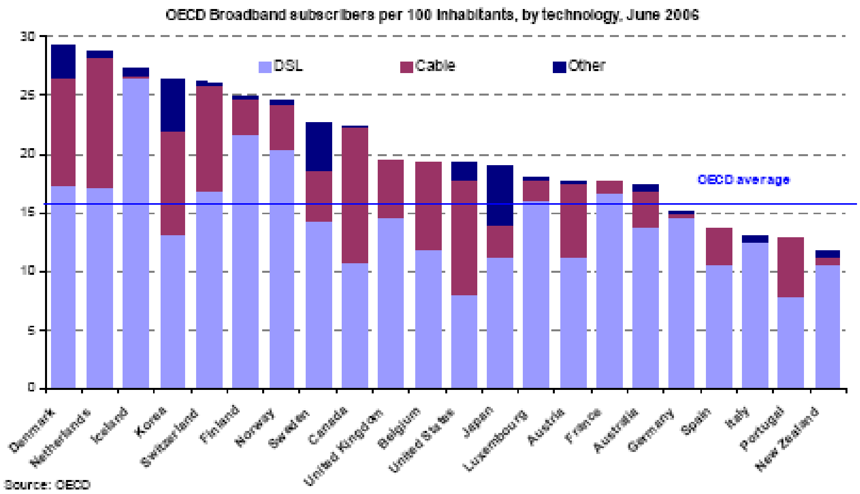


Figure 4-2 Broadband subscribers per 100 inhabitants by technology

In the next figure are represented the five largest broadband markets in Europe by number of broadband connections (June 2006, source Analysis Research). In Italy is also present a form of fiber-optic communication delivery in which an optical fiber is run directly onto the customers' premises: FTTB (Fiber to the building).

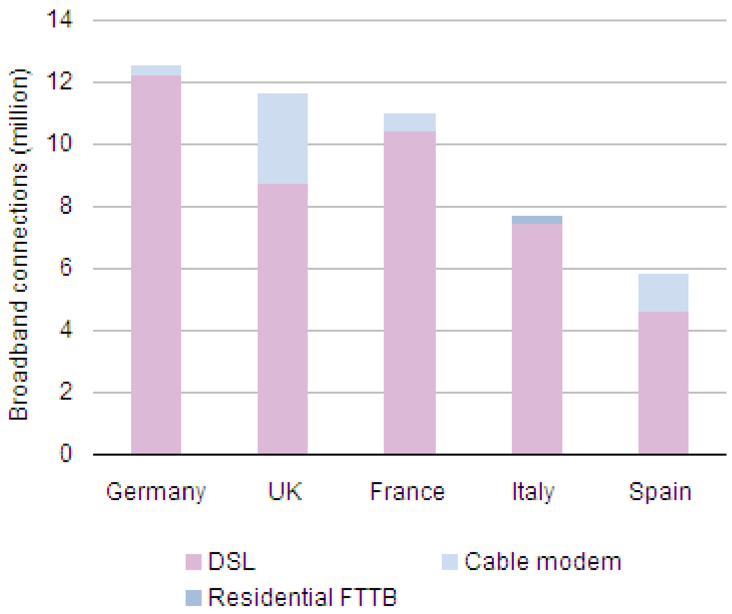


Figure 4-3 Five largest broadband markets in Europe by technology

At the moment Germany remains the largest broadband market in Europe, with 12.5 million connections.

xDSL based networks are expected to remain the dominant broadband access technology in Europe in the near future, but cable will be a credible challenger of telecom incumbents' dominance in the Digital Home area.

On the other hand, one IBM analysis shows that, with the appropriate scale and average revenue per user levels, telecom providers can achieve payback on their network investment for basic Internet Protocol television (IPTV) services over ADSL in a three to five year period. But such services will not be enough to compete with next generation of services from cable / satellite and terrestrial broadcasters, high Definition TV (HDTV), Video on Demand (VoD) and similar services will require far more bandwidth than the current ADSL technology can deliver.

Therefore, the past five years have seen rapid growth in ADSL deployments, mainly in Western Europe, and the next five years will be marked by slower growth of ADSL but faster growth of VHDSL and fiber-based architectures.

4.5.3 Wireless networks

4.5.3.1 WiFi and WiMAX description

WiFi (short for "wireless fidelity") groups certain types of wireless local area network (WLAN) that use specifications in the 802.11 family. The term WiFi was created by an organization called the WiFi Alliance, which oversees tests that certify product interoperability. The fastest WiFi connection can transmit up to 54 megabits per second under optimal conditions.

WiMAX is a standards-based technology born to enable the delivery of last mile wireless broadband access as an alternative to wired broadband like cable and DSL. WiMAX provides fixed, nomadic, portable and, with the version 802.16e, mobile wireless broadband connectivity without the need for direct line-of-sight with a base station. In a typical cell radius deployment of three to ten kilometers, WiMAX Forum Certified™ systems should be able to handle up to 70 megabits per second, for fixed and portable access applications.

WiMAX operates on the same general principles as WiFi, it sends data from one computer to another via radio signals. A computer (either a desktop or a laptop) equipped with WiMAX would receive data from the WiMAX transmitting station (generally using encrypted data keys to prevent unauthorized users from stealing access).

The biggest difference between WiFi and WiMAX isn't speed; it's distance. WiMAX outdistances WiFi by miles. WiFi's range is about 30 m. WiMAX will blanket a radius of more than 50 km with wireless access. The increased range is due to the frequencies used and the power of the transmitter. Of course, at that distance, terrain, weather and large buildings will act to reduce the maximum range in some circumstances, but the potential is there to cover huge tracts of land.

Therefore WiMax was designed to provide (MAN) Metropolitan Area Access, to homes and businesses whereas WiFi was, and still will be used for the foreseeable future, in LAN environments.

4.5.3.2 Present situation and growth of wireless networks

4.5.3.2.1 WiMax evolution

WiMAX evolution: in the year 2006 WiMAX has been initially employed in trials to sustain WiFi and to provide services at home or to offices with fixed aerials outdoor. In the year 2007 are in course experimentations related to direct employment of WiMAX for houses / companies. Next year we expect full employment of mobile WiMAX (standard 802.16e ratified at the end of 2005) in order that the WiMAX technology could both complement the cellular telephone networks and constitute a replacement for citywide WiFi. Mobile network deployments are expected to provide up to 15 Mbps of capacity within a typical cell radius deployment of up to three kilometres. It is also expected that WiMAX technology will be incorporated in notebook computers and PDAs by 2008, allowing for urban areas and cities to become “metro zones” for portable outdoor broadband wireless access.

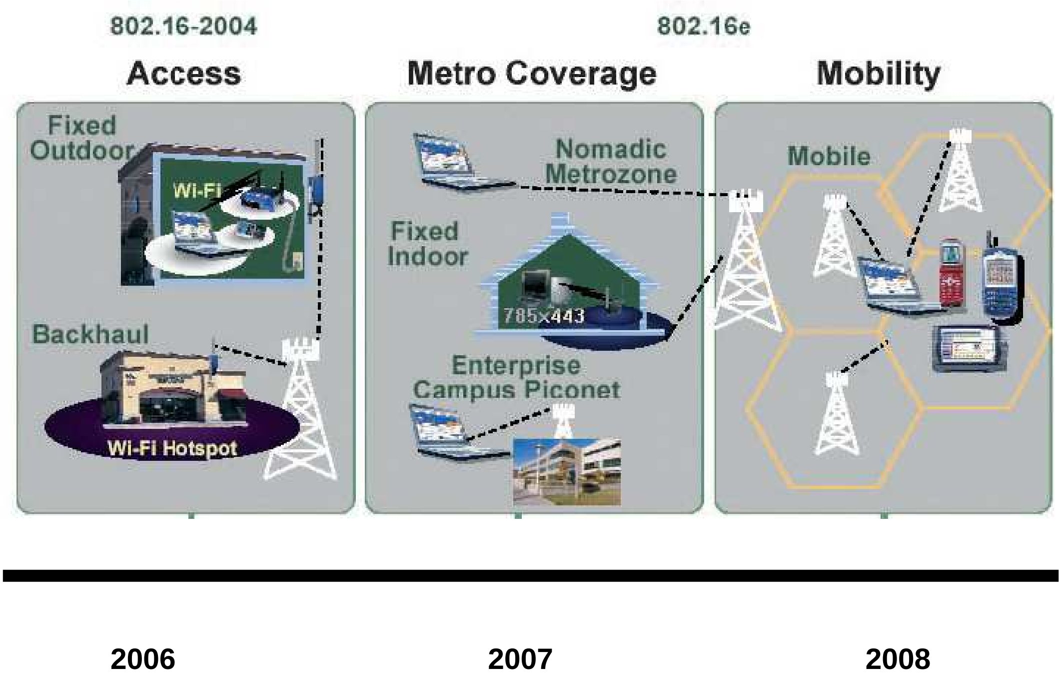


Figure 4-4 WiMAX expected evolution

Therefore it is expected that WiMAX will cover progressively the following applications:

- Optical fibre or ADSL for hot spot services
- WiFi not covered by broadband on wireline
- Low cost broadband for areas not covered by ADSL
- Broadband for business clients mainly where ADSL is not available
- Broadband on demand for meetings / events for a limited period, with short activation set up (few days)
- Mobile broadband, accessible from PDA and mobile handsets
- Low cost broadband to link UMTS aerials
- Broadband everywhere (cars, trains, etc.)

4.5.3.2.2 Toward an integrated network of different technologies

With the evolution of WiMAX toward the mobile it is expected the setting up of a unique integrated network in which coexist different technologies: 3G, WiFi and WiMAX (next table).

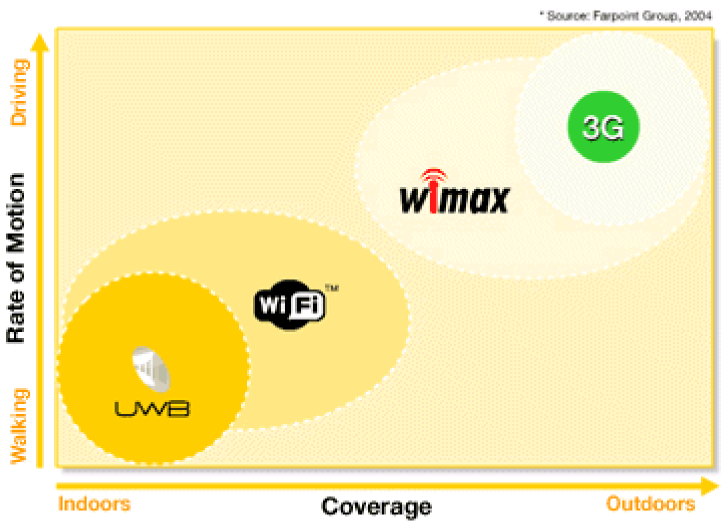


Figure 4-5 Technologies convergence

This kind of model will support the development of new applications and services and may lead companies in updating their communication systems. Among the different applications hypothesis of WiMAX there is the possibility to link together public and private hot spots with the 802.11 standard, but WiMAX could be widely employed also as last mile technology.

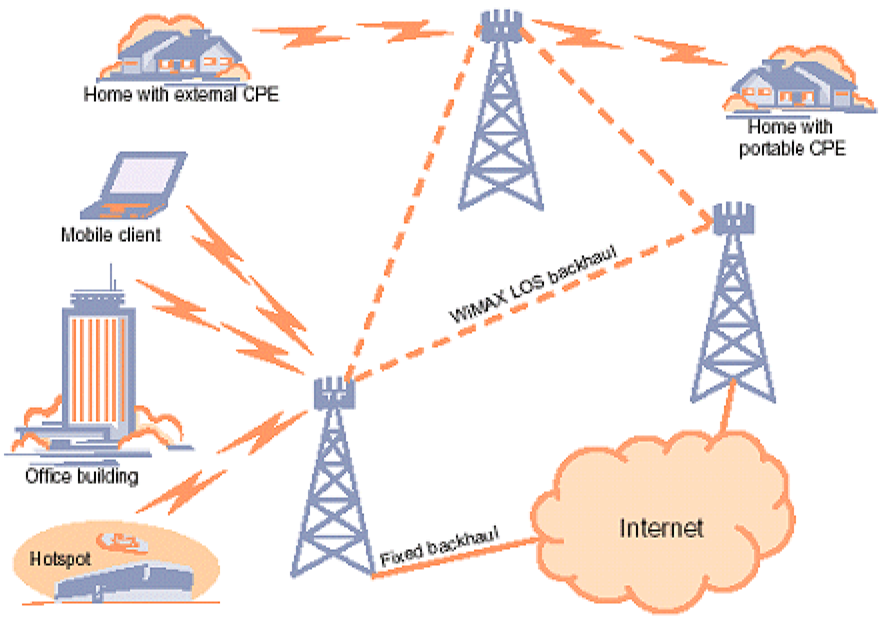


Figure 4-6 WiMAX applications

Therefore WiMax seems to be destined to compete with xDSL technology, as access technology for broadband (in fact 25% of WiMAX forum participants is represented by service providers and operators).

4.5.3.2.3 WiMAX market forecast: from 2007 to 2011

More than 100 million users still access the internet with dial-up, and more than 900 million use the internet occasionally but do not subscribe to a monthly service. The opportunity for

WiMAX to serve those who want to switch to broadband service is huge in many parts of the world where wireline technologies may not be feasible.

WiMAX – as part of a growing market for point-to-point backhaul and grid networks that connect increasingly to localized servers and storage and for person-to-person and group communications, entertainment and file sharing – will see rapid growth from its current starting point. WiMAX is still in the early rollout stage in Europe at this time.

WiMAX could dramatically lower the “wireless premium” for data services (in other words, the difference between the price of accessing an application using a fixed broadband connection as opposed to a wide-area wireless network) by leveraging potentially superior network performance (which implies lower price-per-MB to consumers). To date, the much higher cost of 3G compared to fixed broadband (a 127 percent wireless premium for downloading an MP3 song, or a 91 percent premium for high-speed Internet access) has inhibited demand for wireless connectivity.

WiMAX has the potential to boost demand for wireless data by reducing the cost of integration of wireless interfaces into consumer devices such as laptops, MP3 players, digital cameras and portable video games, and by minimizing the “wireless premium” to accessing the same application with a fixed broadband connection. WiMAX could broaden the portfolio of wireless enabled consumer electronics devices by lowering the wireless interface chipset costs in these devices.

Specifically technology widely used in main WiFi and WiMAX enabled market segments is represented by the following sectors:

- Mobile handsets
- Notebook computers (laptops)
- Gaming consoles and portable gaming products
- WiFi / WiMAX equipment (routers, access points, etc.)
- Other WiFi-enabled consumer products (cameras, printers, etc.)

The following table (source MOSAID Technologies Incorporated) reports the expected evolution of WiFi /WIMAX market size by different sectors.

Market	Market Sizes 2006 - 2011	WiFi or WiMAX Enabled Percentage 2006 - 2011
Mobile Handsets	\$145B - \$200B	0.8% - 31%
Notebook Computers	\$86B - \$113B	89% - 100%
Gaming Consoles	\$16B-\$14B	70%-80%
WiFi Equipment	\$1.4B-\$1.6B	100%
WiMAX Equipment	\$0.2B-\$6.3B	100%

Table 4-4 Evolution of WiFi / WiMAX market size

In the following figures are represented the expected penetration of WiFi / WiMAX in terms of market forecast and percentage of WiFi / WiMAX employment for the years 2006 2011 in different market sectors (source MOSAID technologies Incorporated).

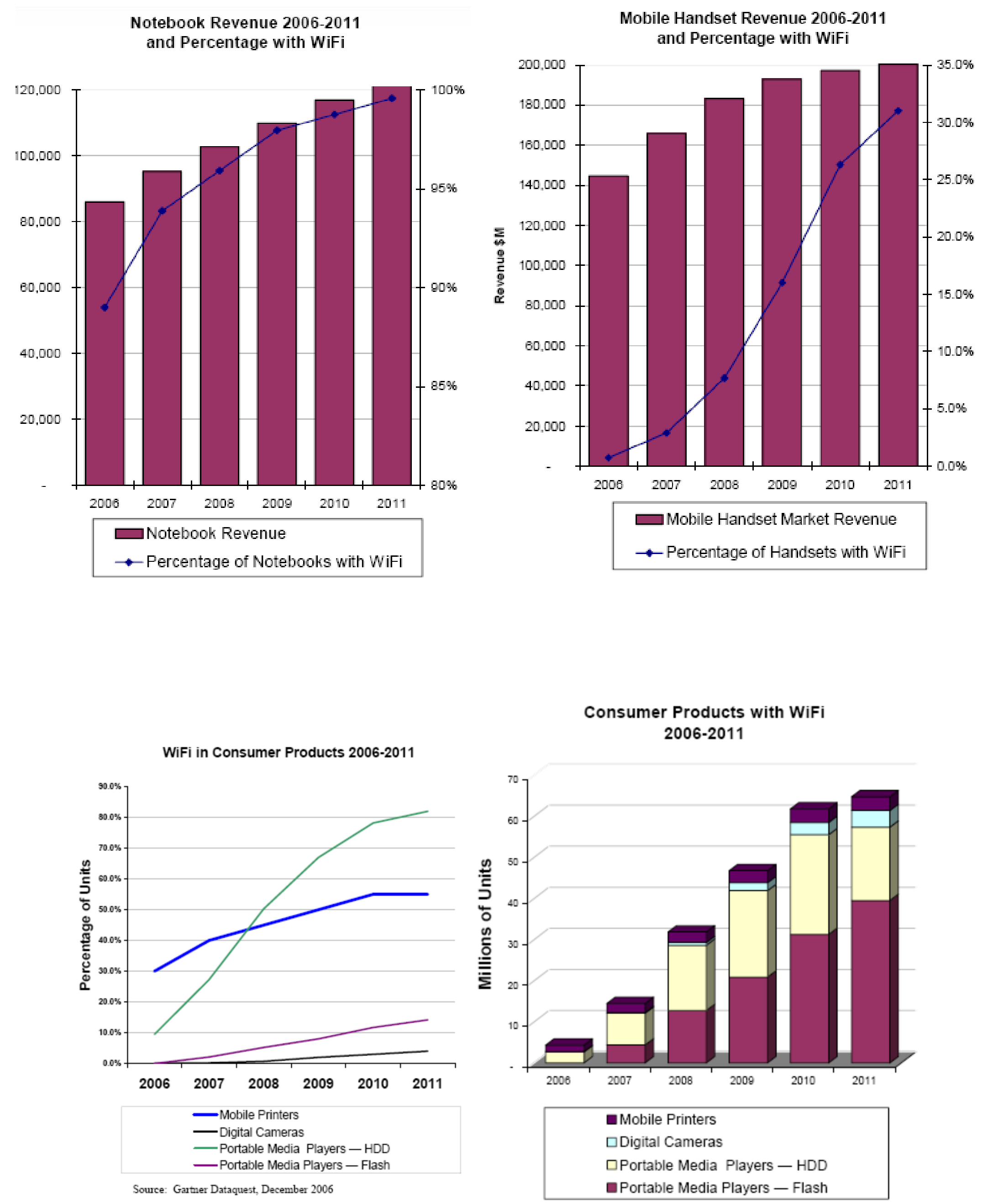


Figure 4-7 Market revenues forecast and percentage with WiFi

4.5.4 Cost comparison among broadband technologies

Broadband may offer traditional telecommunications service providers the chance to enter the video distribution business, it also allows cable service providers to compete in the voice market. Broadband allows service providers to approximately double the average access revenue per user (ARPU) when compared to traditional dialup but it also provides consumers with the opportunity to consolidate multiple lines for voice, and Internet access into a single broadband line.

For the specific broadband service of Internet protocol interactive television (IPTV), IDC estimates that 6% of Western European households will subscribe to services by 2009 with 30 telcos and network operators developing and offering iPTV services. It is anticipated that the largest IPTV markets in Europe in 2009 will be France, Italy and Spain, with strong growth expected in Benelux and Nordic countries. The most successful broadband operators are expected to differentiate product offerings from those already available by providing high-quality content with interactivity.

In addition, for broadband technologies Europe and the United States are expected to reach an average household penetration rate of more than 60 percent by 2010.

Table 4.5 compares the options for Internet access at the present time for different technologies. The figures come from a recent comparative survey in Italy (therefore regional and provider dependent) and should thus be used only as a broad guideline.

	Start up costs (Euro)	Typical cost per month (Euro)	Typical download (mb/sec)	Availability
Fiber optic	60	30-140	5-50	low/medium
Cable modem	70	40-50	1-5	medium
DSL	50	25-35	5-20	medium/high
Dial up	25	7-25	0,028	everywhere

Wi Fi	cheap	free	Depends what is underneath WiFi	medium
WIMAX	TBD (expected 200 when introduced)	TBD (expected higher than cable and DSL)	5-70	nowhere (at the moment)

Table 4-5 Costs options for Internet access

4.5.5 PLC versus wired / wireless technologies

PLC In-home networks, using internal house wiring to provide communications between outlets, can service local area networks as an alternative to conventional wiring or WiFi wireless interconnections (IEEE 802.11a/b/g). In fact In-home PLC networking is a well established technology with devices commercially available from a number of manufacturers.

As far as the cabled lines, the PLC technology is used to bridge the “last mile” between the broadband core (fiber optic) network and the home or office and also within the home (similar to the function of a local area network). In addition PLC is a direct competitor to DSL technology and uses similar modulation techniques. Both technologies exploit existing copper wire networks. The use of existing cabling greatly reduces installation costs as it avoids the need for putting in extra cabling. The commercial PLC offerings are competitive and cheaper than DSL and can extend broadband reach to areas where DSL and cable are not available. To enhance the fixed network by building new local loop infrastructures requires substantial investment. As a result, the barriers to broadband deployment using DSL technology may be high.

With PLC technology the user employs home networking devices such as Ethernet-to-PLC or USB-to-PLC USB (universal serial bus) for interconnecting several computers, sharing printers, or DSL or cable modem connections.

Low voltage PLC networks can provide access to open networks such as the Internet.

With this approach, users gain access through a head-end modem installed in an MV-to-LV transformer providing connections to all subscribers in a neighborhood. The high end modem has a medium voltage link to a high speed core network. Cost reduction is achieved if the MV connection is used for communication since this link minimizes the number of remote modems required.

Although multiple technical and regulatory problems still exist with PLC as an access technology, it can be evaluated as an alternative access technology in regional telecommunications as the ubiquity of power lines is unmatched by either cable or phone networks.

The electricity grid reaches almost 100% of the population, so power line communications, based on existing infrastructure currently providing electrical power, has the potential to offer omnipresent broadband service reasonably quickly and at reasonable cost.

5 MARKET RESEARCH IN NON-EUROPEAN MARKETS

5.1 Central and South America

5.1.1 Region covered

Figure 5-1 Central and South America

5.1.2 Regulatory Situation (PLC Networks and Equipment)

In Brazil an approved legal regulation for use in rendering of services and other activities related to the PLC technology does not exist. There is just an authorization from ANATEL for the realization of tests. The legal regulation must appear from a common effort of ANATEL and ANEEL. This subject has already started being discussed in Brazil and, although there has not been defined a standard, standards defined by international agencies are taken as reference. In the USA, devices and PLC systems must be submitted to the limits of emission established by FCC standard - Part 15. In Europe, the legal regulation established in Norm CISPR 22 that is being reviewed for the inclusion of PLC devices, is used. In Germany (as standard NB30) the limit of radiation is defined in 30 microvolts/meter, measured in a distance of 30 meters. This limit is also a candidate to be adopted by the Brazilian legal regulation.

ANATEL – "*Agência Nacional de Telecomunicações*". It has as attribution the grant of powers, legal regulation and inspection of the telecommunications systems.

ANEEL – "*Agência Nacional de Energia Elétrica*". It has as attribution the legal regulation on Generation, Transmission and Distribution of electric energy.

Following the trend used by ANATEL in the definition of the current effective standard in Brazil - Resolutions 237 and 238, that establish the requirements of electromagnetic compatibility and electric security for terminal devices and telecommunication structure devices of that adopt the European standard, based in the standard CISPR 22 and CISPR 24, it is believed that it is a natural way the adoption of the updates that are being added in the related standard in the scope of already cited Draft (CISPR/I/44/CD) where the treatment to equipment for PLC are defined.

For being the FCC Part 15 the only already existing legal regulation and that covers in a generic form telecommunications systems with wire, perhaps the consideration of the use of the same for the treatment of the networks is an interesting path.

The Electric Energy companies that desire to do PLC systems development tests of must request to the ANATEL an Authorization for the realization of scientific experiments, for a period of up to 2 years, with the objective to regularize these tests. To accomplish such tests, the ANATEL does not request any certified equipment to be installed. The ANATEL requests that the companies contact the staff that works on radio frequency area, with the intention of making a deep and complete study on the Power Line system interferences.

ANATEL does not demand from those supplying companies that intend to act in the national market any PLC systems equipment certification during the evaluation tests however it recognizes that the commercial operation will demand a certification, in accordance with the standard of the sector. The PLC work group together with ANATEL would promote some presentations of the POWER LINE equipments manufacturers interested in developing the technology in Brazil, with the objective of promoting the development and operation of the cited technology, besides improving the inter-relationship between the entities, defining then the methodology to obtain the certification of the equipments to be used inside the national territory.

5.1.3 PLC Networks and Network Operators

The electric energy system is divided in three sectors: generation, transmission and distribution. Nor all electrical companies operate simultaneously in the three sectors. It has specialized companies that operate only in one or two of these sectors, leaving the other activities for third parts. Some utilities in Latin American:

Luz del Sur: (Peru) is an electric distribution company serving the southern half of the capital city of Lima, Peru. Luz del Sur is one of the largest companies in Peru and is the country’s second-largest electric distributor.

Luz del Sur provides electricity to 788,000 customers within an exclusive concession area that covers approximately 3,000 square kilometers. One third of the Peruvian labor force is based in the Lima area, where the country’s economic activity is concentrated.

Chilectra Group Enersis: (Chile) Chilectra became the primary exponent of the market for electric power. In this context, on 1996 acquired the Utility of Colina S.A. (today Utility Colina Ltda.) Located in the northern part of the concession area of the company.

This increase in the concession area meant for the company include 663 Km^2, thereby reached 2 2118 Km, which covers 33 communes in the Metropolitan Region. Chilectra is the largest electricity distribution in the metropolitan area in terms of energy sales.

The Brazil is divided in areas that are yielded to the electric energy distribution companies. In the regions north and northeast of the country these areas normally correspond to the geographic limits of the states. In other regions this does not occur, having small areas and geographic limits that exceed the states. The map below shows the areas and electric companies distributed in the Brazil.

Figure 5-2 Brazil electrical energy companies distribution

Follow is presented information about some Brazil electric companies.

CELG - CELG is an electric energy company that operates in the Goiás state. With four hydroelectric (São Domingos, Manbaí, Mosquito and Rochedo) and about 5.734 Km of transmission and 9.656 Km of distribution lines CELG operates in the generation, transmission and distribution sectors of the electrical energy. The company with more than 3.9 thousand employees, including effective and contracted, has about 1.852.699 units of public and private consumers distributed in 237 cities supplying industries and residence in rural and urban areas.

AES Sul - The AES Sul is a subsidiary of the AES Corporation, the largest global company of the generation and distribution sectors of electric energy in the world. In the Mato Grosso do Sul state Aes Sul takes care of the 118 cities located at metropolitan and Middle West regions. With about a million consumers (7% commercial, 1% industrial, 83% home, 9% rural) it has 1,620 Km of transmission and 53,417 Km of distribution lines and counts with 1,187 MVA of installed capacity.

CEMIG - CEMIG is an electric energy company located at southeast region of Brazil in the Minas Gerais state. It covers approximately 567.478 thousand Km^2, about 96.7% of Minas Gerais´s territory, supplying energy to attend 17 million people in 774 cities. Out of Minas Gerais CEMIG is present in many others Brazil states as Santa Catarina (generation), Rio de Janeiro (commercialization and generation), São Paulo (commercialization), Espírito Santo (generation) and Rio Grande do Sul (commercialization).

With about 6 million consumers (1.2% industrial, 82.1 home, 6.9% rural, 8.9% commercial) it has 21,184 Km of transmission and 379,400 Km of distribution lines with 6,113 MVA of installed capacity.

Eletrobrás - The Eletrobrás is a company of mixing economy and opened capital, with actions negotiated in the Stock exchange of São Paulo, Madrid in Spain, and New York, in the United States. The Federal Government processes more than half of the common and preferential shares of the Eletrobrás and, therefore, has the shareholding control of the company. Also it controls many generation and transmission companies (Chesf, Furnas, Eletronorte, Eletronuclear, CGTEE, Lightpar, Cepel, and Eletrosul) of electric energy that is responsible to produce about 60% of all consumed electric energy in the country. The Eletrobrás still withholds 50% of the Itaipu.

Present in all country, the Eletrobrás companies have 51,039 Km of transmission lines with 40,854 MVA of installed capacity (31 hydroelectric, 16 thermoelectric and 2 nuclear).

ELETROPAULO - The AES Eletropaulo company distributes electric energy to 24 cities in the metropolitan region of São Paulo state, including the capital, attending 16.2 million habitants (8.8% of the country's population). It covers 4.526Km^2 in the most important social economic region of the country with 5.3 million consumers.

Its distribution and transmission lines add up to 40,683 km of aerial electric conductors. There is still 2,977 km of underground network, 1,787 circuits and 1.1 million poles installed in all the concession area.

Other electric energy companies in Brazil are: Aes Tietê, Boa Vista energia, CEAL, CEAM, CEB, CELESC, CELPE, CEMAR, CEMAT, CERON, COELBA, COELCE, COPEL, COSERN- Rio Grande do Norte, ELETROACRE- Acre, COCEL, COOPERALIANÇA, COFL, CTEEP, DMEPC, DMEPC.

5.1.4 Technical Network Configuration and Equipment Suppliers

The Equipment Suppliers in Latin American:

5.1.4.1 Ascom

(Mexico City, Mexico).new to the U.S. market, the technology supports access technology as well as in-premise networking. It tends to have a European flavor, focusing only on the low-voltage side.

5.1.4.2 Corinex

Founded in 1989, privately held by a group of investors, Corinex Communications Corp. is a PLC products manufacturer, with DS2 chipset based. In Brazil their representative and distributor are Sojitz do Brazil S.A, Procable Energia e Telecomunicações Ltda and INNOVUS.

Some PLC products supplied by Corinex, with respective features are presented below:

CXP-AV200-ETHC: easy installation CPE device for indoor use that features: 200 Mbps, triple play service, Plug and Play, RADIUS server authentication, VLAN and OVLAN, Fixed IP or DHCP, MASTER/SLAVE configuration, Programmable bandwidth allocation.

CXP-MVA-GWY: Medium Voltage Access Gateway/Regenerator device for outdoor use, that features: 200 Mbps, triple play service, DES/3DES encryption, 802.1Q VLAN & optimized VLANs, Bridging Support for up to 2048 MAC addresses, SNMP protocol support, configurable frequency notching of frequency bands including Amateur Radio and Restricted Frequency Bands.

5.1.4.3 Current

CURRENT Technologies International GmbH is a globally recognized technology pioneer in the field of broadband communications over the electricity supply grid. The subsidiary consists of substantially all of the assets of Ascom Powerline Communications AG. It does have neither representative nor distributor in Brazil.

Some PLC products supplied by Current, with respective features are presented below:

APC-2000: easy installation CPE device for indoor use that features: 205 Mbps, Easy installation (plug-and-play), no additional configuration to be done by end-users, Secure data transmission (encryption, VLAN), Automatic provisioning support (DHCP, configuration files), Remote management support (SNMP).

API-2000-GW: Low Voltage Gateway/Head-End device for indoor use that features: 205 Mbps, Time Division repeater, Head-End support, Support for up to 32 simultaneous PLC connections (slaves), Bridge table capacity of up to 64 MAC addresses, High receiver sensitivity to ensure high distance coverage, HTTP based configuration and monitoring interface, Industrialized command line console as alternate means of configuration, Simple and easy to use system concept for VLAN and QoS services, PLC signaling to minimize configuration parameters and enhance robustness, SNMP agent to facilitate management of larger networks.

API-2000-LV: Low Voltage Gateway/Head-End device for indoor or outdoor use that features: 205 Mbps, Time Division repeater, Head-End support, Support for up to 64 simultaneous PLC connections (slaves), Bridge table capacity of up to 1024 MAC addresses, High receiver sensitivity to ensure high distance coverage, HTTP based configuration and monitoring interface, Industrialized command line console as alternate means of configuration, Simple and easy to use system concept for VLAN and QoS services, PLC signaling to minimize configuration parameters and enhance robustness, SNMP agent to facilitate management of larger networks.

API-2000-MV: Medium Voltage Node/Head-End device for indoor or outdoor use that features: 205 Mbps, Secure data transmission, Full remote network management, Integrated DHCP and FTP services to support automatic remote configuration of any size network, SNMP agents enable efficient integration into standard network management systems, HTTP for individual node configuration/monitoring, API-2000-MV units are small enough to fit anywhere, Standard interfaces ease the interconnection.

5.1.4.4 Ilevo (Schneider)

Ilevo was founded in 2000 and was acquired by Schneider Electric. Ilevo is a leading provider of solutions for broadband communications infrastructures using electrical networks, with the purpose to constitute a PLC network intended for multimedia, energy, and power & control applications. Schneider Electric (Stock market of Paris: Schneider Electric SA) is the world-wide leader in Management and Control of the Electrical Energy, causing that is available, reliable, efficient and safe in all type of applications in the markets of the construction, the industry, the energy and infrastructure and the home. Schneider Electric manufactures and commercializes an extensive product range and services through his global marks, Merlin Gerin, Square D and Telemecanique participating in four strategic activities: the electrical distribution in average and low tension, the industrial control and the automatism. Schneider Electric uses to 105,000 people at global level, she has operations in 190 countries and she is present at in 190, and sales by €13.700 million in 2006 through 15,000 points of sale

Some PLC products supplied by Ilevo, with respective features are presented below:

ILV201: easy installation CPE device for indoor use that features: 200 Mbps, triple play service, Plug and Play, RADIUS server authentication, VLAN and OVLAN, IP configuration by DHCP, FTP client configuration and upgrade files by TFTP.

ILV2110-ILV2120: Low Voltage Repeater device for outdoor use that features: 200 Mbps, Time/Frequency Division, support for up to 64 simultaneous PLC connections, 1024 MAC addresses table.

ILV2010: Low Voltage “Head-End” device for outdoor use that features: 200 Mbps, support for up to 64 simultaneous PLC connections, 1024 MAC addresses table, SNMP support.

TE: Modular configurable Low and Medium Voltage device for indoor use that features: 200 Mbps, SNMP support, 802.1Q VLAN & Optimized VLANs.

5.1.4.5 Inovatech

InovaTech was founded in 1999 and is a global group of companies with extensive experience in high and low speed powerline communications technologies. InovaTech's product includes all elements required to build telecommunications networks including Customer Premises Equipment, Head Ends, Repeaters, Medium Voltage Transition Nodes, and low cost high performance PLC adaptors used for distributing broadband data services over wiring.

Some PLC products supplied by Inovatech, with respective features are presented below:

IpCat: CPE device with easy installation for indoor use that features: 200 Mbps, triple play service, Plug and Play, 802.1D Ethernet Bridge, 802.1Q VLAN, Quality-of-Service (QoS).

PurCAT: Low Voltage repeater device for indoor use that features: 200 Mbps, Embedded software protection, Remote software upgrade.

MvNode: Low to Medium Voltage translation node device for indoor use that features: 200 Mbps, Embedded software protection, Remote software upgrade.

5.1.4.6 Mitsubshi

In Brazil, Mitsubishi Electric and Hypertrade Telecom work together in the PLC market. Mitsubishi supplies devices while Hypertrade is responsible for business, project and technical support.

Some PLC products supplied by Mitsubshi, with respective features are presented below:

Modem: easy installation CPE device for indoor use that features: 45 Mbps, triple play service, Plug and Play.

Repeater: Low Voltage repeater device for outdoor use that features: 45 Mbps, VLAN and QoS support, DHCP configuration.

Node: Low to Medium Voltage translation node device for outdoor use that features: 45 Mbps, VLAN and QoS support, DHCP configuration, SNMP management.

5.1.5 Services offered and PLC-based Network Applications

5.1.5.1 Typical applications and services

The main telecommunication services applicable to the broadband network can be grouped in the following categories: data communication, voice, audio and video. Each category has operational, functional and performance requirements that have to be attended in order to reach adequate quality and service provide levels. The analysis of the business scenarios must contemplate the instalment of an ample gamma of services with focus is to provide broadband access by means PLC technology.

Broadband distribution has reached 5% on average in South America, with greatest penetration in countries like Brazil, Argentina, Chile, Columbia and Peru. Currently, the annual penetration of broadband roughly doubles each year, with the majority of that business going to the telcos. The broadband service in Brazil is expanding. The broadband connections increased 40% in September of 2005 to September of 2006. Considering all of the cities with ADSL broadband access networks or Cable Modem) in Brazil there are 1923 cities attended, representing almost 20% more than in 2005. This means that 1358 million people live in cities where there is an option of residential broadband access, representing 72.4% of Brazilians. There is a great advantage in numbers of users favouring the ADSL operators. Today they have about 3.9 million subscribers, which mean that they obtain a level of 9.6% of penetration on the total domiciles covered by its networks, or 32% of penetration if considered only the domiciles with classes A or B. The Cable Modem operators, with near 1.1 million subscribers of the of internet access services, have a penetration of 5.7% of the domiciles covered by its networks where there is offering the services; however, the growth was bigger for Cable Modem operators in the year of 2006, which shows that they are more aggressive.

The following chart illustrates the total of broadband connections in Brazil.

thousand	1T05*	2T05*	3T05*	4T05*	1T06*	2T06*	3T06*
ADSL	2,088	2,406	2,762	3,092	3,359	3,594	3,880
Paid TV	393	4523	528	629	789	914	1,036
Others (Radio)	30	44	60	75	80	92	105
Brazil total	2,510	2,902	3,350	3,796	4,228	4,600	5,050

Table 5-1 Total of broadband connections in Brazil

Source: Operators, ABTA and Teleco, does not include satellite and dedicated IP.
* T05 – Trimester 2005; T06 Trimester 2006

Brazil finished Jun/06 with 4,743 thousand connections of broadband, being 78.7% DSL, 17.0% Cable, 3.8% Wireless and 0.5% Satellite.

Between the most important broadband operators, the great prominence of covering is Brazil Telecom (BrTurbo) that expanded even more its ADSL network in comparison to 2005 and today reaches a total of 1274 cities. The Telefônica (Speedy) also expanded the network in 2006, reaching 346 cities, as well as Telemar (Velox), that now reaches 221 places. With exception of Vivax, that expanded its services of broadband to 33 places, the Cable Modem operators did not expand their networks in year 2006.

The services of broadband with the greatest potential are the ones from Telemar, Telefônica and the Vírtua, from the Net Serviços. The Velox, of Telemar is in a few cities in comparison with the covering of the network, but are well representative in the economic point of view, and reach 31.2% of the consumption potential index (IPC) of Brazil. The Speedy is available in markets that represent 29% of the Brazilian consumption potential. The Vírtua, with much less cities, is in markets that represent 26.1% of the national IPC. Next comes the Brazil Telecom, with 24.6%, the TVA (Ajato) that attends the cities with 15.4% of the IPC and, at last, the GVT that offers ADSL in places with 13.8% of IPC. With the acquisition of the Vivax, the Net will reach 32.5% of the Brazilian market potential, being thus the operator with the best market to be explored. It will need investments, since its network attends only half of the domiciles, in average, of these cities.

In the beginning of 2007 some services should stimulate the selling of broadband, just like it happened with the Net Serviços in 2006 that started offering combined packets of Cable Modem, Internet and voice. By the Teles, it is expected the launching of the IPTV. The demand for audiovisual contents in the internet is also a booster of the market of broadband, as well as the services of VoIP and the proper networks expansion, like WiMAX in the bands of 3.5 GHz, 10,5GHz and in the (2,5GHz).

5.1.5.1.1 Telecommunication infrastructure for the "Triple Play" services.

The broadband services are converging to a unique network with voice, data, audio and video, today denominated "Triple Play" services. For example, Telefonica Peru's believes that with such build outs, triple-play services will be easier to sell, operate and maintain. Yet, up to 50% of the region is not reached by basic telephony (voice) services, meaning a large upgrade effort for basic voice would also be required in order for sustained broadband and IPTV growth.

Then, an infrastructure of broadband access should provide sufficient band to give support to all of the types of services and applications, having to be upgraded, allowing that its capacity is extended in the future. Some services, like video on demand, do not have an established market, but they are presented as a trend, constituting in promising market, over all in a niche with raised consuming potential.

5.1.5.1.2 VoIP service and IP telephony

The service of IP telephony must be distinguished from the service of voice transport over a IP network (VoIP), in which is established a point to point connection based on IP addresses, because the service of the telephony requires resources for treatment of necessary telephony signalization, for originated calls and for finished calls, guiding plan, numeration plan, billing plan and integration with the fixed and mobile conventional telephony network.

There are a number of reasons for the increasing interest of phone companies and VoIP providers in the emerging market. The countries, in general, lack substantial infrastructure for broadband, have a high cost for traditional phone service.

Companies investing in VoIP across Latin America and South America are anticipating that they will generate revenue in several ways. There will be call handling, both inbound and outbound communications. There will be monthly subscriptions, with bundled minutes for national and international calling. There will also be calling cards – for the corporate and consumer markets.

VoIP growth is driven by the emergence – generally – of digital subscriber lines. Latin America is now emerging as a major digital subscriber line (DSL) market, adding 1.2 million subscribers from January to September 2004, a growth in subscribers of more than 72 percent, according to the DSL Forum.

Many VoIP suppliers in Central and South American and in other countries and some of them are: Deltathree, Interlink Ecuador, LatiNode and Turinco (a publicly traded company controlled by investor Sir John Baring, recently acquired Arvana Networks), Interlink,.

Brazil is leading the way, gaining over 620,000 DSL subscribers, and three countries, Mexico, Argentina and Peru, have experienced more than 50 percent growth since the beginning of the year.

A total of 85.3 million DSL subscribers globally exhibits a growth of more than 39 percent so far in 2005, according to the latest data produced for the DSL Forum by industry analyst Point Topic. DSL – the world's most popular broadband technology – added another 24 million subscribers in the first nine months of 2004, as more than half a million people each week are choosing DSL around the world.

Also there are many VoIP suppliers in Brazil and in other countries and some of them are: Free VOIP, GigaFone, GigaVoip, CMSW Telecom, DELIXFONE, Intervoz e LIGVoip.

Additional services to be provided as identification of calls, conference, voice mail, can also be explored.

Will be available for the user:

- to receive more than one call simultaneous
- being able to redirect the call in case of busy to another connected telephonic device
- service of answering machine with box of messages per user
- identification of calls and electronic agenda with speed dialing
- blockade of calls, restricting the types of calls with bigger billing (cell phones and international calls, etc…)
- register of calls with consultation by browser (data, hour, duration, number of destination, total in minutes and cost of the call)
- pre- payment and pos- payment

5.1.5.1.3 E-Services

E-Commerce: In Latin America and mainly Brazil, there are 3 big players in the area of electronic market, the Submarino, the Americanas and the Mercado Livre that in the year of 2006 beat the record reaching a value of 1.1 billion dollars in transactions by the internet in all of Latin America, and in the second semester of 2006 there was a fusion of the Submarino and the Americanas. The annual performance of Brazil in the e-commerce is increasing each time, and only in the year 2006 it increased 76%. The table 4 presents the number of this sector in Brazil.

Year	Value of movimentation (in billions of reais)
2004	9,9
2205	17,2
2006	30,9
2007	50,25
2008	80,19

2010	100,9

Table 5-2 Virtual retailed market in Brazil

(Source: Gazeta Mercantil)

E-Banking: In Latin America and the world the banks offer many services by the internet, like transferences, payment of bills, however because of secure issues, many users know about the advantages but prefer to not use the service.

Other electronic services, by the web, are E-Franchising, E-Learning, E-Auctioning, E-Marketing, and others.

5.1.5.1.4 Service suppliers

Below are some examples of e-services.

E-Commerce:

Name	Web address
Americanas	www.americanas.com
Submarino	www.submarino.com.br
Shoptime	www.shptime.com.br
Mercado Livre	www.mercadolivre.com.br
Amazon	www.amazon.com
Ebay	www.ebay.com

Table 5-3 Suppliers of E-Commerce service

E-Banking:

Name	Web address
Banco do Brazil	www.bb.com.br
Banco Itau	www.itau.com.br
Banco Real	www.bancoreal.com.br

Bradesco	www.bradesco.com.br

Table 5-4 Suppliers of E-Banking service

E-Learning:

Name	Web address
Centro Universitário Feevale	www.feevale.br
Instituto Superior de Educação do Paraná	www.wnet.com.br
Pontificia Universidade Catolica de Minas Gerais	www.pucminas.br
Universidade Federal de Lavras	www.ufla.br
Universidade Federal de Minas Gerais	www.ufmg.br
Universidade de Caxias do Sul	www.ucs.br

Table 5-5 Suppliers of E-Learning service

5.1.5.1.5 Videoconference

The Videoconference is an interactive communication way that allows two or more people to communicate in different places, with audio and image communication and in real time. It has also been called visual collaboration and is a type of groupware. It differs from videophone in that it is designed to serve a conference rather than individuals.

The core technology used in a videoconference system is digital compression of audio and video streams in real time. The hardware or software that performs compression is called a codec (coder/decoder). The resulting digital stream of 1's and 0's is subdivided into labelled packets, which are then transmitted through a digital network of some kind (usually ISDN or IP). The use of audio modems in the transmission line allow for the use of POTS, or the Plain Old Telephone System, in some low-speed applications, such as video telephony, because they convert the digital pulses to/from analog waves in the audio spectrum range.

5.1.5.1.6 Service Provider

The Videoconference service can be offered by any Internet provider. To use this service, the user shall have an appropriate hardware (PC, Webcam and Microphone), access to the Internet and proper software, such like: MSN Messenger (Microsoft), Portrait (Microsoft), Yahoo! Messenger (Yahoo!), CUSeeMe (First Virtual Communication) and VIGO (VCOM).

5.1.5.1.7 IPTV

IPTV (Internet Protocol Television) has become a common denominator for systems where television and/or video signals are distributed to subscribers or viewers using a broadband connection over Internet Protocol. The South American Telco TV (or IPTV) markets are tightly interwoven with the broadband build out in that region.

Unlike Europe or the US, the major tier 1 telcos do not have “agreements” with Microsoft for use of their IPTV middleware. For now, that means the market is open and free for competition by middleware, DRM and VOD vendors who want to compete on “best of breed” basis. Several companies, including Telefonica, have formed partnerships with vendors to offer turnkey IPTV services; and IPTV Americas is also offering turnkey IPTV systems in South America, along with UTStarcom.

Regulations issues: IPTV in general has flown under the radar of heavy regulation. Consensus among telcos seems to be that this will continue so long as IPTV is an extension of Broadband services, and that best efforts will be made to extend services to all socio-economic groups (A,B,C and D markets). In fact, in some markets (like Brazil), IPTV may prove to be a political convenience to the government, rather than forcing broadcasters to convert to expensive Digital Terrestrial TV. As with other regions, managing the regulatory situation will remain a balancing act on a country-by-country basis. It appears that the least regulated markets like Argentina, Chile and Peru will be the most hospitable to IPTV; and will create market conditions already receptive to new Pay TV services like IPTV. For this same reason, Telefonica is investing in cable properties like Cable Magico in Peru and TVA in Brazil as a way of gaining a position and experience in the Pay TV business.

Often this is in parallel with the subscriber's Internet connection, supplied by a broadband operator using the same infrastructure but over a dedicated bandwidth allocation. Main fixed Telecoms in Latin American and Brazil, have pilot projects in progress for test the technology, therefore, the Fixed Telecoms will be able to offer a triple service with voice, data and video. In the table 6, some IPTV providers are presented.

Provider	**Country**
AT&T http://www.att.com	EUA
BellSouth http://www.bellsouth.com	EUA
UTStarcom http://www.utstar.com/	Latin American and world
Telemar http://www.bellsouth.com	Brazil
Telefônica http://www.telefonica.com.br http://www.telefonica.com.pe	Brazil and Peru
Brazil Telecom http://www.Braziltelecom.com.br	Brazil

Table 5-6 IPTV providers

5.1.5.1.8 Video on Demand

Video on Demand (VoD) is a system that allows users to select and watch video content over a network as part of an interactive television system. VOD systems either "stream" content, allowing viewing in real time, or "download" it in which the program is brought in its entirety to a set-top box before viewing starts. The latter is more appropriately termed "store and forward". The majority of cable and telco based VOD systems use the streaming approach, whereby a user buys or selects a movie or television program and it begins to play on the television set almost instantaneously. The carriers and service providers will can to offer advanced applications like: Movies-on-Demand, Interactive video games, Interactive news television, Catalogue browsing, Distance learning, Interactive advertising and Video conferencing, medical applications.

5.1.5.1.9 Service Providers

The table below shows the main VoD providers, the network technology and the country.

Provider	Technology	Country
COMCAST http://www.comcast.com/	Cable	U.S.A
Time Warner Cable http://www.timewarnercable.com/	Cable	U.S.A
NTL http://home.ntl.com/	Cable	U.S.A
Telefônica http://www.speedy.com.br	ADSL	Brazil
Brazil Telecom http://www.Braziltlecon.com.br	Optic Fiber	Brazil
Telemar http://www.velox.com.br	ADSL	Brazil
Net Serviços http://www.virtua.com.br	Cable	Brazil

Table 5-7 VoD service providers

In Brazil, the VoD applications are recent and some carriers have invested in network and made some demonstrative tests.

5.1.5.1.10 Monitoring and Surveillance

The monitoring through video systems is used to monitoring critical places and is reaching excellent results. The monitoring systems are been used for to detect remote riots ambient like fires, overflows, burials, etc.

As alternative to the analogical systems, the digital monitoring systems, is based in IP networks, can resolve some problems of the CCTV system (Closed Circuit Television). Use cameras to monitoring presents some advantages and can be used in a gamma of applications:

- Residences monitoring: Video monitoring systems have been installed in residences as a plus mechanism for patrimonial and people security, in addition at the other kind of security systems used. During the day, while the people are at the work, the video monitoring system can monitor the residences and send automatic alarms for the cellular ones or to the policy, as well as sending the images of monitored places in real time.
- Industry monitoring: Cameras installed in the industrial local network can restrict problems with robbery and offer subsidies to verify if the operational processes are being followed by the employee. Cameras monitoring the production line can be programmed to send alarms if something abnormal occur, like the bad machine functioning or process.
- Traffic Monitoring: The traffic monitoring can help the conductor's decision in the choice of access ways. The video images are sent by the Internet, informing the traffic situation in real time, preventing congestion. Emergency Services can also use the images for to attend the occurrences more efficiently.
- Banks monitoring: Financial institutions can install a monitoring system in bank agencies and ATM machine to restrain frauds or robberies.
- Government: The video monitoring has been used for the crime combat in the urban centers. Video cameras in strategically points send images in real time for the observation centers, making possible coordinate actions of the security agency. The current monitoring systems present requirements of high performance and

accessible cost, and have proven being an efficient way for the crimes reduction in critical areas.

5.1.5.1.11 Service Support and Utilities Applications

The public utility services (energy, gas, water, sanitation and oil), also known as utilities services, represent one of the market segments that must have growth in the next years. In accordance with the Itelogy Partners (http://itelogy.com), the telecommunications market applied to the utilities companies, mainly as for the automatic control systems and measurement (AMR - Automatic Metering Reading) must grow approximately of US$ 10 MM in 2005 for US$ 40 MM in 2008.

The main benefits of the AMR adoption by the utilities are:

- The identification and losses control (commercial/ operational)
- Remote actions like turn on/turn off the service
- Business Intelligence
- Curve survey of the real consumption
- Rational consumption of energy, water and gas
- Where to invest in infrastructure with precision, knowing, for example, where is the exactly point in the network that must have install a transforming or a valve
- Differentiated billing by schedule

5.1.5.1.12 The AMR Market

The total Americas utility meter market, including all utility types, is estimated to be comprised of 26.5 million units in 2004, with a projected CAGR of 3.8% to 31.9 million units in 2009.

The report covers the electricity, gas, and water meter markets; spilt by product type and geographic region. Adoption of AMR enabled meters is also covered in this report; split by utility type and geographic region.

Technologies used in Latin American utilities generally follow international standards and operating procedures common in North America. And growing customer bases require utilities to adopt larger and more efficient systems.

Thus, leaders of Latin American utilities are beginning to see the benefits of automated methods of reporting field events. The use of pen and paper is dwindling, and hand-held computers are becoming widespread.

Utilities' yearly budgets contain large funds for computer and telecommunications hardware and software. In this race to obtain the latest and greatest technologies, the need for guidelines and regulations is significant.

In the computer and telecommunications industries, data and protocols typically are based on U.S. standards. Though in metering, utilities follow various models: the northern part of South America uses U.S. types of systems, but the southern region uses European-style systems. Brazil has its own protocols, perhaps slanted toward Europe, but with numerous distinctions.

Governments' interest in advanced technologies is prompted by citizens' eagerness to enter the high-tech world. Latin America has more than 6 million Internet users – more than the Middle East and Africa combined and about one half of all of Asia. And the number of subscribers is growing exponentially.

A perception of local political instability is probably the single most influential factor keeping many foreign investors from entering the Latin American utility market. By nature, investments in utility infrastructures must be long term.

Another complicating factor is that Latin American governments historically have viewed infrastructures as national assets, so making these infrastructures independent was considered too economically risky. But the move toward privatization makes this mind-set obsolete.

5.1.5.1.13 Service Providers

The following table shows the main AMR service providers for utilities, the used network technology and the country.

Provider	Network technology	Country
Itron http://www.itron.com/pages/index.asp	Radio Frequency, Cellular, PSTN, Power Line	World
Echelon http://www.echelon.com/	Optic Fiber, Radio Frequency, Power Line	World
Enermet http://www.enermet.com/en/	GSM, PSTN and Power Line	World
Telvent http://www.telvent.com/	Optic Fiber, Radio Frequency, Power Line	World
Elster http://www.elstermetering.com/en/	GSM	World
V2 Telecom http://www.v2telecom.com.br/hp.htm	Cellular Networks: CDMA, TDMA/1XRTT, GSM, GPRS	Brazil
Nansen http://www.nansen.com.br/	PSTN, Cellular, Power Line	Brazil
Ecil Informática http://www.ecil.com.br	PSTN, Cellular and Ethernet	Brazil
Logger AMR http://www.logger.com.br/beta/br/solutions/solutions.htm	GSM	United States and Latin America

Table 5-8 AMR service providers

5.1.5.2 PLC cases

This document has for objective to point the main electric energy operators situed in the South and Central America, that they are investing or looking for to invest in technology PLC, and to present some notice on each one of them.

5.1.5.2.1 Argentina

- Operator

  - Schneider Electric

In Argentina, the company, present from 1982, counts with more than 700 employees, a central seat of 35000 m², 18 commercial agencies and delegations, and sales by $245 million in 2006. In addition, in Argentina it produces and it commercializes the Plasnavi mark, leader in the local market.

- The news

  - Forum PLC of Argentina (http://www.plcforum.org.ar/)

Forum PLC of Argentina is a civil association whose objective is to constitute a permanent scope of discussion and stimulus of the use of technology PLC in Argentina. It is integrated by manufacturers, distributing companies of electrical energy, suppliers of services and other organizations like universities, institutes of investigation, consultants, etc.

The General Coordinator of Forum PLC of Argentina is Lawyer Hernán Fagnilli Fuentes. In the Posgrado in Digital TV of the Faculty of Engineering of the University of Palermo he has himself including a matter that denominates “TV on BPL”, that is in charge of the Lic. Fagnilli.

- Schneider offers broadband through the mains in Argentina

http://www.espanol.frecuenciaonline.com/home/contenidos.php?id=15&identificaArticulo=1490

http://www.canal-ar.com.ar/Noticias/NoticiaMuestra.asp?Id=4697

In JUL/07

As of December it would be possible to be acceded to Internet of broadband through the electricity. Therefore, when fitting a cable to the power outlet will be able to be had connection without needing another electrical wiring in addition to existing in the homes and the offices. The company in charge to offer this service will be Schneider Electric, from where they assure that this technology will be implemented where others do not arrive.

"The convergence in the communications networks and the creation of contents on the part of the users demands a speed of ample and stable transference, and that is what guarantees to use the mains to transmit data in broadband", explained Adrián Liotine, manager of Marketing in Argentina de Schneider Electric.

This service, llevo call, are based on Power Line Communications, an application that provides Internet and service of telephony through electrical energy. This technology already is used in countries like Brazil, Spain and France.

On the other hand, the possibility of offering Internet through electrical laying began to be proven by Edenor, by the end of the last year. One hopes that system PLC collaborates with the elimination of the Digital Breach.

"Also, this modality also is observed with interest by the telcos in as much, when making possible a bandwidth of 200 Mbps, the PLC would assure the yield the future IPTV, this is, the television through the broadband", clarified.

5.1.5.2.2 Chile

- Operator

  - CGE

The General Company of Electricity is the second greater distributor of energy of Chile, with a base of clients who surpass the 570 thousands - of which only a 33.1% are residential and a volume of sales by on 2,400 million of kWh to the year. It operates in the regions Fifth, Sixth, Seventh, Ninth - like distributor and Twelfth – zone in which besides to distribute, it generates energy To it adds the supplying in the province of the Maipo in the Metropolitan Region.

In the outside, CGE - to traverse of the National Company of Electrical Force (CONAFE) – participates in a partnership that controls the Argentineans Company of Electrical Distribution of Tucumán (EDET) and Company Jujeña de Energía (EJESA-EJSED), adding between both more than 400 thousand clients. To it the recent acquisition of 38% of the company of electrical transmission Transnoa through its Argentine branch Norelec is added, where CGE has 50% of the property.

In addition to the electrical business, it controls 55.46% of the Gasco company (Gas Santiago) and, through this one, participates in the property of Metrogas and Cemento.

- The news

  - CGE develops telecom project

http://www.highbeam.com/doc/1G1-93758361.html

Nov/02

The Chilean to power distributor CGE (General Compania of Electricity) there are got to 2 years provisory license to start up its Power Line Communication project to Seth up to data & voice Access technology through electric to power wires. CGE is to offer services AT the VIII Region.

5.1.5.2.3 Costa Rica

- Operator

  - ESPH

E.S.P.H S.A. is in charge at the present time to offer to its clients the services of electrical energy, public lighting system, potable water and sanitary sewage system, but with an approach different from which it had before his transformation.

It is important to rescue that after the transformation, one has intensely worked in the improvement and extension of the mains. Aside from it, they have been designed and implemented systems to improve the control of the network and the quality of the voltage provided to the users. The clients of industrial type count in addition, like with the potable water distribution, circuits of distribution dedicated to guarantee a continuous service to them, to the height of the international standards.

In the last years, additions and complements to the offered services have been made in regular form by the Company, as they are it the studies of the market and of quality, as much of water, as of electrical energy. Such they contribute to avoid the waste of these valuable resources and to optimize his use, benefiting to the user economically and simultaneously, taking benefits environment.

Within the surroundings of the transformation of the Company, the same one has including an environmental vision to his to drive, with the objective of being leader in the planning and execution of programs that allow the use of the natural resources of balanced form. On the other hand, to extend its reach, the Company looks for like opening its supply to the satisfaction of other services, which at this moment have to position the deprived municipalities and other beings, such as: garbage collection, Internet, etc.

ESPH takes care of more than 56.000 thousand clients, with a capacity installed of 2MW and a volume of sales by on 384GWh to the year.

- **Digital Heredia project**

It allows of the impact of the technology in the development, the Company of Publics Services Heredia S.A. invests resources in the consolidation of the Project “Digital Heredia”, which tries to offer a novel service of telecommunications constituted by voice, data and video, to satisfy the necessities with the different sectors involved in the economic development from the province such as the industrialist, commercial, educative, residential, etc.

The project looks for to positively hit the herediana community, segmented in residential and educative, commercial and industrial sectors for those who their necessities of the service of telecommunications are varied and diverse depending on the group to which they belong.

Digital the Heredia Project has as it reaches, the benefit of the service of Voip (fixed Telephony on IP), data (Internet, mail, web site, etc) and video (digital television) to the present and potential clients of the central corner of Heredia.

It is tried to offer a service with an accessible tariff to the herediana population, without this jeopardizes the quality of the equipment and technologies to use and the designs of the necessary communications diagrams for the benefit of the service.

At the moment the Company develops the studies to know the viability the project and to establish the agreements with the state beings to execute a plan pilot

- The news

  - Racsa negotiates with rural cooperatives to extend Internet service will expand by mains

http://www.larepublica.net/_vernoticia.aspx?idart=28583

Jan/06

In a matter of a month, the students of the school Esquivel Ascent in Carthage will be able to have access to Internet with only connecting their computers to a power outlet.

The administrators of this educative center, as well as of several public organizations, will not occupy to divide the telephone line nor to pay a subscription to companies of television by cable, to place antennas either to receive a satellite signal of microwaves or.

Power Line Communications (PLC) who allows to connect the computer to a special modem and this a any power outlet, so that the access to the network is offered through electrical system.

Carthage will be the first population center that will prove east system the next month, in schools like the Jesus Jiménez and the Esquivel Ascent, the Hospital Max Peralta, the Red Cross and the Technological Institute, soon to extend it to other sites public, residential and companies, according to confirmed Mario Jiménez, representative of the Together Administrator of Services Public of Carthage (Jasec).

“We are going to take the plan in a month with tests to low tension and soon we will raise medium tension in places like the Technological one, which we want is that the client has several options of connection so that she chooses”, she adduced Jiménez.

The low and average tension depends on the type of electrical connection that has each place and of its level of consumption, for that reason is necessary to adapt the equipment for each case. Nevertheless, this mechanism would be used to expand the accesses to Internet in other zones of the country.

Luis Carlos Rosales, representative of the company PLC – that works in alliance with Jasec- commented that already negotiations with some rural cooperatives, specially with Coopealfaro have taken place, in Alfaro Ruiz.

In addition Radiográfica Costarricense, S.A. (Racsa), also handles the possibility of applying the electrical connections in the metropolitan area, for which it is in the stage of discussion of projects with the National Company of Force and Luz (CNFL), according to said Mario Estrada, representative of Racsa.

"With the Company already the tests have taken control initial and it hopes that this same year we begin to put the first facilities. Also we are negotiating with other cooperatives to implement it and to expand the access to the network", indicated Estrada.

Some of the companies that would be interested in applying this type of accesses are the Company of Services Public of Heredia (ESPH) and Coopelesca in San Carlos. The users single would have to pay the cost of the modem that at the present time goes up to around the $250, as well as the monthly tariff, which is considered in a cost similar to the normal connections, that is to say, about $35.

The technology prevents that pirate connections can take place, inasmuch as would exist a control center to detect each connection and to determine if the modem is enrolled or no.

- Internet by electrical line fails, shows problems of RFI in Carthage

http://ti0rc.org/phpBB2/viewtopic.php?p=15&sid=1cf37ac34ac8ddb601a8d4d85ed965e9

SET/07

The Plan of Internet by electrical line that is promoting Radiográfica Costarricense SA (RACSA) altogether with JASEC (Together Administrator of Electrical Services of Carthage) in the province of Carthage or began to show the effects denounced by ARRL (American Radio Relay League) for or several years.

The old wirings of the province, as well as the lack of quality in electrical systems of the buildings causes that the transmitted signal is interrupted frequently, and at the same time has caused problems of interferences in the band of broadcasting A.M. and frequencies of taxi drivers.

System PLC is being rejected in center of Carthage due to the problems previously mentioned, but now JASEC has in the sight to residential but new of the province, because these if they have the quality required in his wirings to transmit the signal of Internet. There is the no news of when it will be initiating RACSA the residential tests in but the new ones, nor of what residential it will be using for the same ones.

5.1.5.2.4 Paraguay

- Operator
  - ANDE

In 2000, ANDE had 963,815 users connected to his network. Of which, a 83.65% were residential clients (806.231). 5 people are considered/calls to account, which gives a total of connected population to the network of ANDE equal 4.031.156 people whom, on the considered total population (5.500.000 inhabitants) a percentage gives to a total of 73.3% electrification.

ANDE considers that the electrification index is of a 83% but, for it, considers the total of users (including commercial and industrial), which is incorrect.

Although the amount of users directly connected to the network of ANDE is around 73.3%, as it calculated, is due to consider, as they detect independent studies to it, that many rural users of popular districts or areas connect themselves to the network through neighbors, number that arrives, in certain cases, until a 10% of the total.

In addition, the residential users of average and high economic layers, when the network does not arrive from ANDE, auto-generate their electrical necessities by own account. Although these layers are a minority in the rural areas not yet electrified.

It can be considered, for that reason, that the electrification index is around 80% in all the country.

Whereas the electrification index is superior to 95% in urban areas, it is probable that in rural areas it is around 60%, as they prove recent studies.

At least in the Eastern Region (40% of the surface of the country), where 97% live on the population, all the main urban centers are connected to ANDE and the rural areas next to the network.

In the Region Occidental or Chaco (60% of the national territory), where 3% live on the population, are also electrified the more important towns and productive areas, connected to ANDE.

Some isolated towns have systems on the basis of fossil fuels and most of the cattle, typical establishments this region, they lack the electrical, safe service, in certain cases, of his own auto-generation. It either does not have electrical energy, except for exceptions, the important indigenous population of this region (near 80,000 inhabitants).

5.1.5.2.5 Peru

- Operator
  - Luz del Sur

Luz del Sur is a deprived company of distribution of electricity that takes care of more than 741.424 thousand clients in the South-Eastern zone of Lima, capital of Peru.
Their sales surpass the 385 million annual dollars, turning it one of the most important companies of the country, and one of the main electrical distributors of Latin America.
Within the main advances of management of last the 11 years, they emphasize:

- Electrification of the 100% of the zone of concession.
- Incorporation of more than 245.668 thousand new clients, benefiting to more from a million people.
- Losses of energy of 7,8%.
- More of US$388 million investment that has allowed modernizing the electrical system to be able to give a continuous and reliable service.
- Construction of 9 electrical sub-stations with the technology more outpost of the world and extension of the mains to more sectors of the city.
- Installation of more than 60 thousand lights.
- Computational Platform of last generation.
- Greater efficiency in the service: Reclamations taken care of in less of a month, lighting system reclamations I publish in less than 3 days, new domiciliary connections in less than 5 days, among other examples.

- The news
  - Development of PLC in Peru

http://www.osiptel.gob.pe/OsiptelDocs/GCC/NOTICIAS_PUBLICACIONES/PUBLICACIONES/FILES/boltec082007.pdf

JUN/07

At the moment one has in Peru initiatives for the unfolding of this technology, at the moment the company Optical IP, concessionaire of the local carrying service, has initiated a project pilot, who bets to offer services of broadband using PLC. This test makes it with the Luz del Sur company, company of distribution of electrical energy. This project has a small network of test in the city of Lima and would be available for any operator who requires it, which will have to arrive at the electrical substation by its own means or by means of the rent from services to a third operator. With it the potentiality takes advantage of the omnipresence of the mains.

To be fulfilled the expectations of growth raised by the developers of this project (Optical IP and Light of the South), enormous possibilities for the development of competition in the market of the provision of accesses of broadband in benefit of the population are opened, are of the corporative, residential sector and PYMEs. With it they will also have more supplies not only in quality but price terms, that are an important aspect for the support of the different applications or services that are supported in the broadband.

5.1.5.2.6 Venezuela

- Operator

  - EDC

EDC counts on near 110 years of history and is greater the private electrical company of Venezuela, dedicated to the business of generation, transmission and distribution of electricity, covering near 1 million clients in the metropolitan area of Caracas and Yaracuy State. From year 2000, the company is controlled by American group AES Corporation.

- The news

  - Branch of the EDC takes to project pilot of Internet to Educative Unit in Petare

http://www.laedc.com.ve/ArticlesDetail.asp?CategoryId=10878&Modulo=1&ParentCat=10871&Depth=1&CategoryId2=10908&ArticleId=273250

MAR/07

The Electricity of Caracas started up in the Educative Unit Estadal Consuelo Navas Tovar, a project BPL pilot (Broadband Power Line) which, in addition to this school, is being developed in the Urbina and a residential set in the Cadelaria.

The Electricity of Caracas, through one of its branches, started up in an Educative Unit of Petare, a project BPL pilot (Broadband Power Line), technology that allows to offer to a service of access to Internet broadband by means of the mains.

The Educative Unit Estadal Consuelo Navas Tovar, is the place that was taken like reference to present/display the BPL pilot, which, in addition to this school, is being developed in the Urbina and a residential set in the Candelaria. Altogether, it includes/understands the installation of 350 modems in the indicated urbanizations and will allow the company to explore and to study the operation of the service, as well as of the range of alternatives that will be able to be provided through this technology.

Julian Nebreda, executive president of the Electricity of Caracas, informed that “with technology BPL the EDC will be able to take to Internet broadband and service of new generation to the clients of their served area. The Electricity of Caracas always has been a pioneering company in the country and with this initiative, first in its style in Venezuela, a new project of Social Responsibility will also be being been executing that it looks for to take the technology to zones difficult and to educative communities”.

In fact, the selected Educative Unit will as much count on service BPL in its areas of direction and administration like in the hall computer science. For this classroom, additionally, the EDC contributed computers and placed labelled with advice of position and ergonomics. Also, 3 laboratories of electricity were reconditioned and messages of efficient use of energy and security with electrical systems were placed. With these initiatives they will be benefiting more than thousand students from the establishment.

The fundamental advantage of this technology is that it allows to have access to Internet in any place where arrives the mains. Also, BPL handles greater speeds to those of a service ADSL (broadband) and can get to be 4 times quicker than the plan faster than offers at the present time in the national market. BPL is raised with a lever on the infrastructure of electricity of the EDC reason why it opens possibilities of services to zones where there are no the facilities of Internet.

In Brazil, amongst private sector initiatives, those carried through by the APTEL deserve prominence. Such initiatives have allowed the realizations of PLC forums, where especially Broadband are discussed, making possible the exchange of technological information, regulatory and business-oriented aspects. Also it promote meetings of diverse enterprise, consulting sectors and manufacturers, all involved on the development and implantation of PLC products and services in Brazil.

APTEL – “*Associação de Empresas Proprietárias de Infra-estrutura e Sistemas Privados de Telecomunicações*”. It has as goal to promote the growth to use of the infrastructure and telecommunications systems of its associates, through joint actions in the business-oriented areas, regulation and technology.

In the end of 2006, the city hall of Porto Alegre (RS), inaugurated the neighborhood of Restinga, located about 30 Km of the capital and with 130 thousand habitants, the regional administrative center of Restinga (CAR) and, using the PLC technology, the municipal structure turned out to be the first in Rio Grande do Sul to establish internet access from a electric energy network. The solution gained space for solving a local geography problem. The neighborhood is located between mounts and the alternative is to use the electric energy network until a determined point and the wireless technology for the distribution of the signal.

Other PLC cases in Brazil that already happened some time ago are: Barreirinhas, pilot-project based in the PLC technology, a project of digital inclusion in the city of Barreirinhas, connecting the city hall, the health secretary, the school, the CEMAR and the SEBRAE. In 2001, the Companhia Paranaense de Eletricidade (COpel) carried through some tests in Curitiba, taking internet connection in high speed to more than 50 houses, using the outdoor PLC technology. In 2003, electric energy companies like Cemig, Eletropaulo, Copel and Celg already had projects related to this technology. Also in 2003, the Light, in Rio, accomplished the first demonstrations of access by electric network in commercial, residential and public school buildings, through a partnership with the government of the Rio de Janeiro state.

5.1.5.2.7 CELG Field Trial

This IntelliGrid Architecture Field Trial by CELG chose the broadband PLC technology as telecommunications infrastructure. This trial already was started and meets in progress.

The test plant presented was chosen by concentrate a representative circuit founded on the CELG distribution infrastructure and contemplate some of its main elements to be monitored. Also the location in the neighborhood of the CELG operations center facilitates the installation, diagnosis and maintenance of the equipment to be installed.

In system the main functionalities have been defined as:

- Remote measurement of energy (consumption and demand) for evaluation of changes in load profile and commercial losses detection.
- Remote monitoring of breakers installed in the medium voltage branch.

These functionalities are detailed as follow.

System Architecture

The Figure 5-3 below presents the elements to be monitored, the equipment used and the system topology. Related to the figure will be listed the elements to be monitored:

- Visual monitoring of the medium voltage breaker - Poste 1, 4 and 6.
- Remote measure of the three phase energy metering consumers - Poste 2, 5, 6, 7, 8.
- Remote measure of the global three phase energy metering - Poste 3.

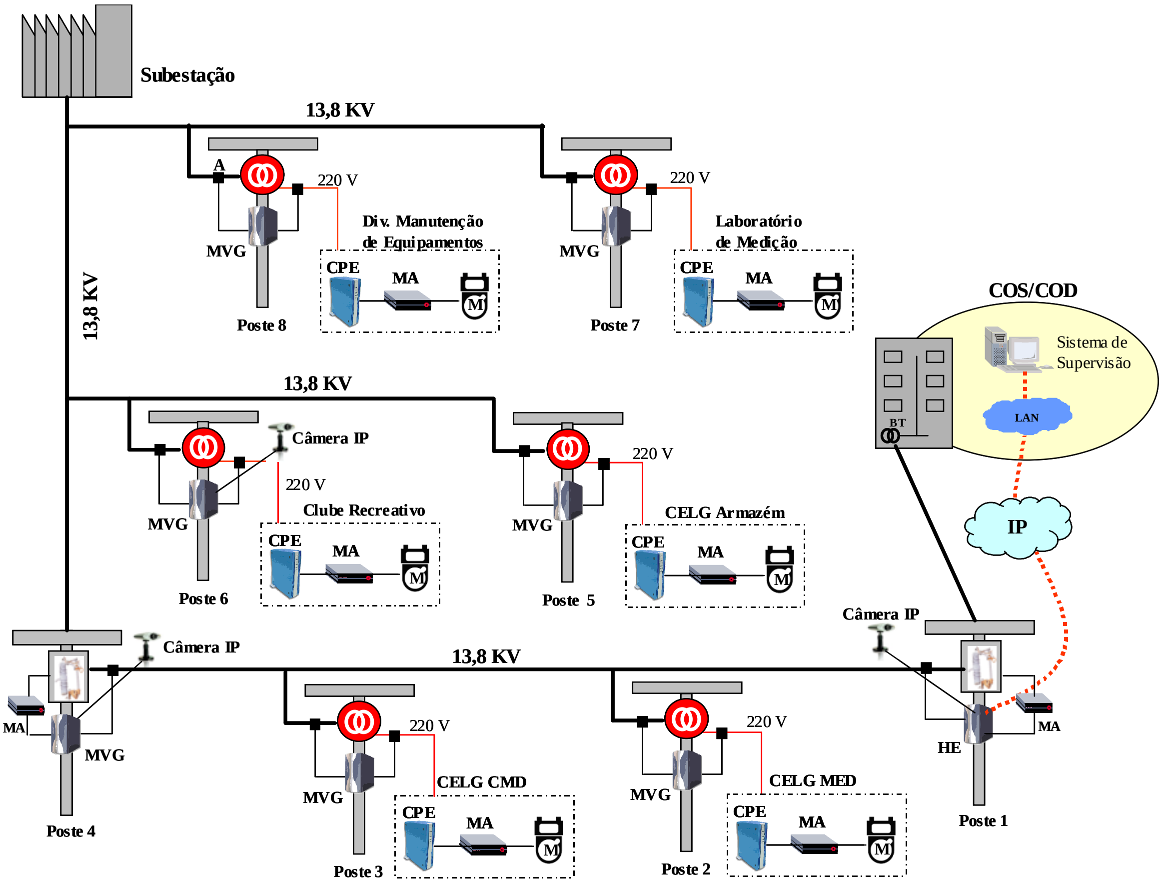


Figure 5-3 CELG Field Trial

Remote measurement of energy

The management system will be able to read stored data automatically from electric energy meter through PLC network. If necessary an Adapter Module (proprietary hardware / software) will be used as bridge to acquire data from meter in its standard pulses output or optical serial port, and than send it in an Ethernet port through the PLC network to the management system.

Energy balance

A goal of this project is to make possible an analysis of the energy balance for electric branches. Thus a global meter will totalize all energy supplied to a branch and compared with a sum of energy supplied to all consumers meter installed in the same branch.

An illustration is presented in the figure below, where kW (Global Meter) = kW (Meter Circuit 1) + kW (Meter Circuit 1).

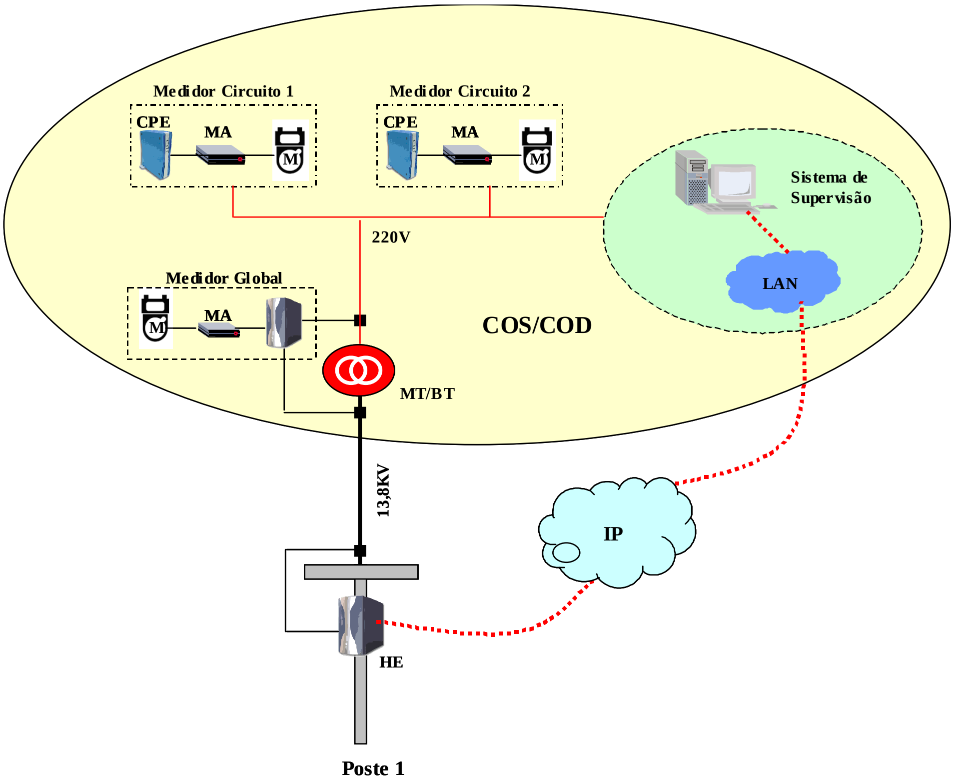


Figure 5-4 Energy balancing

Visual monitor

An IP camera will monitor breakers installed in the medium voltage and used as overload protection for the medium to low voltage transformer. The images collected by camera will be transmitted to the management system through the PLC network. This will permit to inspect the breaker status (closed or open) and than detect fail occurrences.

Management system

Management system is proprietary software specially developed as part of this pilot test and installed in the CELG operational center as supervisory tools to collect, store, process and analyze received data. Also it will allow visualizing image from IP cameras.

Geographic processing of the supervision points

The monitoring points were mapped through the CELG geo-processing software allowing the visualization of the passage of the electric networks of medium and low voltage, the localization of each point and the respective distances between the points to the management center. Figure 5-5 illustrates the mapping of the supervision points.

Such information is of utmost importance for the PLC network project stating references to equipments location definition of applications parameters, data network integration, environment characteristics analysis, etc.

If necessary due to network topology and distance between the monitoring points, some PLC repeater equipments will be necessary to be installed in specific points of the network to strengthen the PLC signal.

Note: The mapped points can suffer alterations in result of the technical and ambient characteristics to be defined in the phase of analysis of the project requirements.

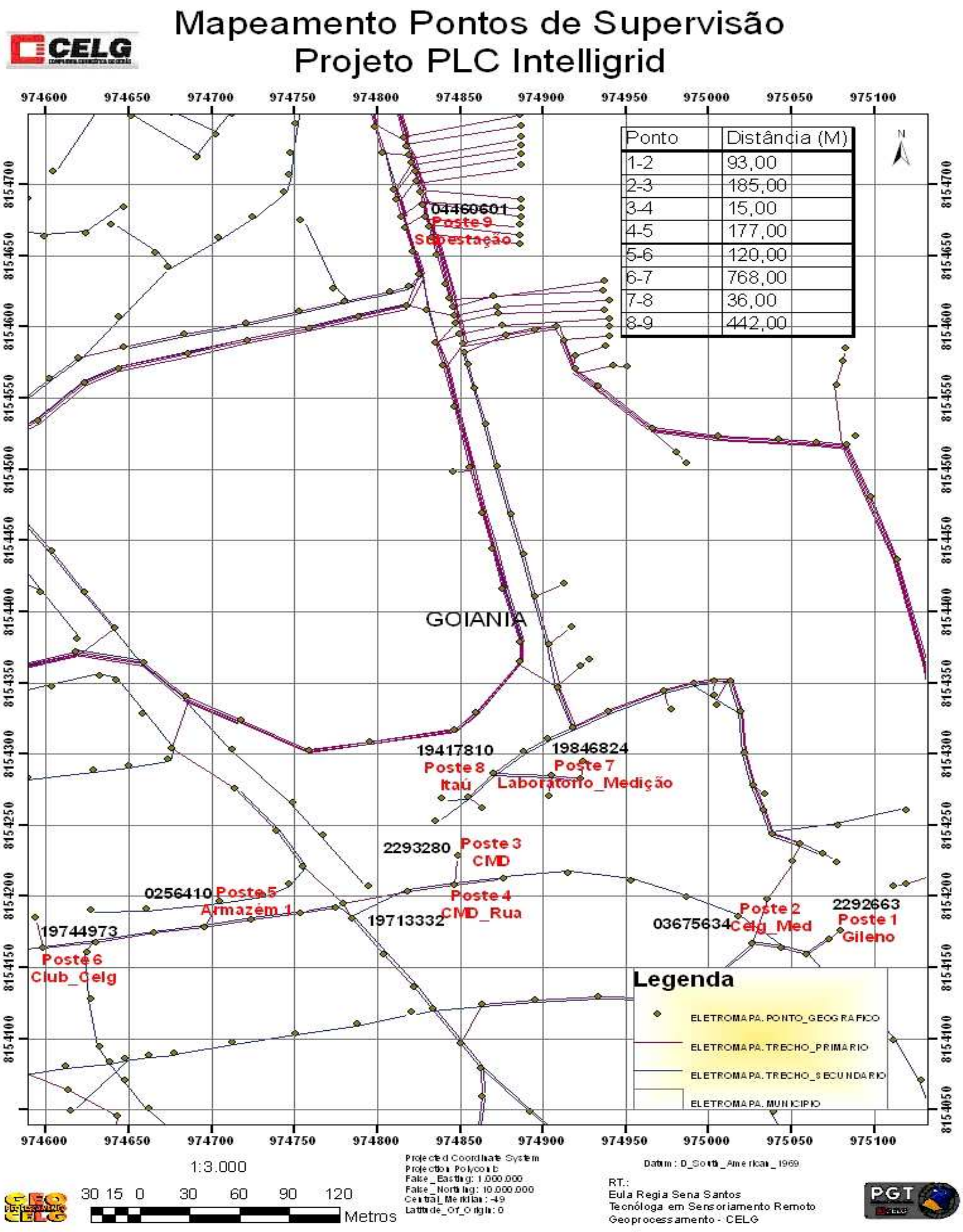


Figure 5-5 Supervision points map

5.1.6 Barriers and future Opportunities for the PLC Technology

5.1.6.1 Barriers

Currently, five main reasons exist that must be considered as barriers for growth of PLC technology: interoperation, radio interference, wireless technology competition, lack of regulation and energy meters without support for IP communication.

Interoperation: Although the many tests already executed and others still in progress, devices of different manufacturers do not have full interoperation capacity. Efforts in this direction have been made by alliances and normative agencies through standards definitions such as HomePlug Powerline Alliance and IEEE P1675.

Radio Interference: The OFDM modulation used in PLC devices produces radio interference with short waves communication equipment. It is necessary that standard been created and respected norms for pacific and correct interoperation of the two systems.

Wireless: Wireless technologies as WiFi, WiMax, Zigbee, etc are competing in some PLC applications.

Regulatory: The regulatory lack contributes so that it has certain distrust in use of the PLC technology, for the risk to substitute or to modify the installed equipment, resulting in the needs to make new investments in already installed plant.

Meters: Although some last generation of meters support IP communication capability, their use requires more investments due to it higher cost or by necessity of substitution of the already installed meters.

5.1.6.2 Opportunities

As opportunity can be presented the possibility of PLC technology been used without the necessity of great investments in infrastructure supplying broadband Internet. One important factor is that the electric network has coverage of 95% of the Brazilians houses. The Brazilians government project named “Luz para todos” has a goal of reach 99% of Brazilians houses having electricity. Another factor that contributes for the interest in the technology is the great growth in the demand for broadband services that only in Brazil presented a growth of about 40% in 2006, totalizing 1.6 million of new connections.

For electric energy distribution companies it means the easiness implantation of an AMR system and the possibility to add new services in their portfolio generating new business.

5.2 USA

5.2.1 Introduction

The USA has long been known for its progressive development of the PLC technology in the home environment . PLC modems for home use are standard equipment. Only recently have efforts begun to also develop standards for the access market.

The biggest push to develop the PLC technology further comes from the utility industry.

In the United States, it has been recognized that without significant further investment in the utility networks, the existing U.S. system will not reliably support the increasing demand for energy.

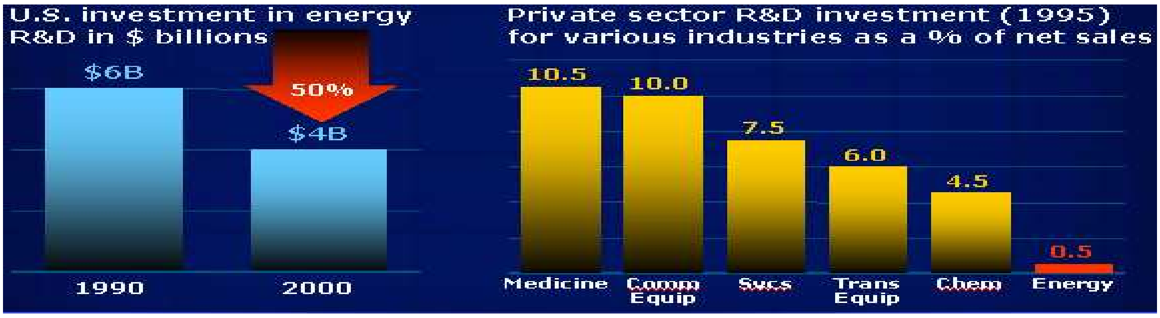


Figure 5-6 US investment in the energy sector

Source: EPRI

Without corrective action, EPRI cites significant potential losses by the year 2020.

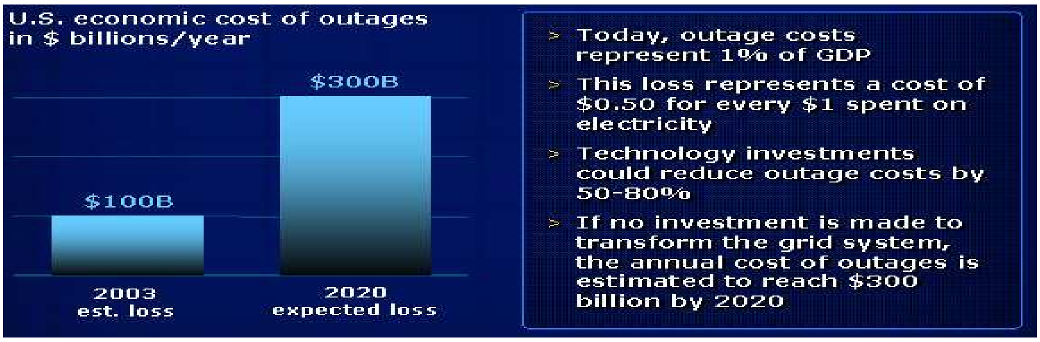


Figure 5-7 Cost of outages

Source: EPRI

The PLC technology represents the most promising technology which can contribute to the management and optimisation of the existing networks.

As with any business endeavor, regulatory issues have to be addressed. A positive note on the regulatory front: the FCC considers BPL an excellent candidate as a competitive broadband technology, and the utilities that can implement these networks as viable competitors to other large providers. Thus, the FCC is interested in encouraging the success of the BPL industry. The Bush Administration in general also has made broadband – through a variety of technologies – a focus of its telecommunications policy.

On the state level a number of states (Texas, California being the first) have enacted BPL specific laws which aim to define what utilities can and cannot do with BPL services. Exemplary for such legislation was the Texas Law SB5:

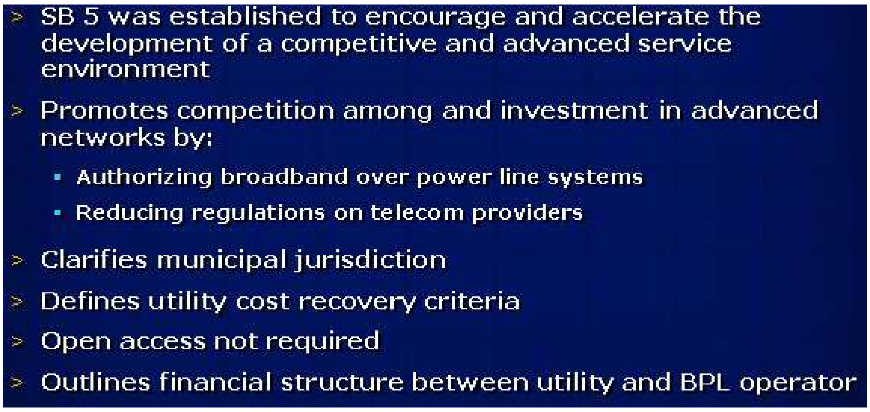


Figure 5-8 Texas state BPL legislation

Source: TXU, IQPC conference 2006

For example, utilities in Texas and California cannot offer broadband services commercially to their customers. Instead these utilities can create affiliates to deploy the technology or team with third-party BPL integrator/operators.

As can be seen by the following comments, significant strides have also been made on the national level in the USA on the regulatory side as concerns the use of BPL equipment for both the access and in-house markets.

5.2.2 Regulatory Situation

The Federal Communications Commission has maintained its support of the PLC technology to allow it to become an alternative broadband technology. As such, a number of PLC-related technical issues are presently being analyzed and publicly discussed:

- Definition of access and in-house PLC
- Emission limits
- Interference Mitigation
- Measurement Guidelines
- Equipment Certification

5.2.2.1 Emission Limits

The FCC has affirmed the below emission limits for BPL:

Regulation	Distance	µV/m	dBµV/m
Carrier Current Systems 1-30 MHz	3	3000	69.5
	10	270	48.5
	30	**30**	**29.5**
Class A Digital Devices 30-88 MHz	3	300	49.5
	10	**90**	**39**
	30	30	29.5
Class B Digital Devices 30-88 MHz	**3**	**100**	**40**
	10	30	29.5
	30	10	20

Table 5-9 FCC proposed emission limits 2007

5.2.2.2 Interference Mitigation and Problem Resolution

To minimize interference, the FCC has established the following rules:

- Access BPL systems shall incorporate adaptive interference mitigation techniques to remotely reduce power and adjust operating frequencies, in order to avoid site-specific, local use of the same spectrum by licensed services. These techniques may include adaptive or "notch" filtering, or complete avoidance of frequencies, or bands of frequencies, locally used by licences radio operations.
- Access BPL systems shall comply with applicable radiated emission limits upon power-up following a fault condition, or during start-up operation after s shut-off procedure, by the use of a non-volatile memory, or some method , to immediately restore previous settings with programmed notches and excluded banks, to avoid time delay caused by the need for manual re-programming during which protected services may be vulnerable.
- Access BPL systems shall incorporate a remote-controllable shut-down feature to deactivate, from a central location, any unit found to cause harmful interference, if other interference mitigation techniques do not resolve the interference problem.

<u>Problem Resolution Process</u>

The FCC has set up some basic guidelines to expedite the problem resolution process:

- BPL operators must post system/contact information to BPL data base within 30 days prior to the operation
- Licences must contact the BPL operator first before complaining to the FCC
- FCC imposes good faith duty by BPL operators and licences to identify and resolve interference
- Time frame to respond to complaints:
  - in general: according to a mutually acceptable schedule
  - for public safety radio interference complaints: 24 hours to respond – and if no response in that time – shut down.

If interference complaints are not resolved between the parties, the FCC will act as a backstop and will accept the complaints.

Specific rules will be set up to minimize potential problems. These include the definition of "frequency bands of exclusion (to protect aeronautical frequencies), geographic zones of exclusion (e.g. for coast stations), and consultation areas (such as 30 day advance notice to protect aeronautical, astronomy and radar receiving stations).

Additionally, the NTIA (National Telecommunications and Information Administration) will carefully tailor and monitor protections from BPL interference.

5.2.2.3 Measurement

For in-house BPL, in-situ testing around homes and along power lines connected to the home. Lab tests will take place for computer peripherals. For access BPL systems, measurements will take place in situ along MV and LV lines for overhead installations. In situ testing will take place at radials around transformer stations for underground BPL systems. The extrapolation factor is 40 db/decade < 30 MHz, 20db/decade > 30 MHz.

5.2.2.4 BPL Equipment Certification

All BPL equipment that is manufactured, imported, marketed or installed after July 7, 2006 must be certified by the FCC to complain with the aforementioned rules. 26 applications for equipment certification have been granted by the FCC for 6 BPL companies.

In addition to the FCC, the following organisations are involved in the BPL authorisation process:

FERC - The Federal Energy Regulatory Commission (FERC) is the United States federal agency with jurisdiction over interstate electricity sales, wholesale electric rates, hydroelectric licensing, natural gas pricing, and oil pipeline rates. FERC also reviews and authorizes liquefied natural gas (LNG) terminals, interstate natural gas pipelines and non-federal hydropower projects.

NTIA – the National Telecommunications and Information Administration is The National is the President's principal adviser on telecommunications and information policy issues, and in this role frequently works with other Executive Branch agencies to develop and present the Administration's position on these issues.

Currently, the NTIA analyses in the Phase 2 BPL Report expands on the scope of NTIA's Phase 1 analyses and applies the FCC Part 15 rules and measurement guidelines or Access BPL systems. The results of these analyses confirm that the Commission's access BPL rules, measurement guidelines, and special protection provisions will limit the interference risks for federal radiocommunication systems.

NARUC- the National Association of Regulatory Utility Commissionars produced a white paper on BPL which took a favorably stance toward BPL.

5.2.3 PLC Networks and Network Operators Companies

5.2.3.1 BPL Trial and Commercial Activities

One of the more encouraging aspects of the BPL market today is not the number of vendors with systems for sale, but rather, the number of electric utilities with technology trials and/or commercial systems that can vouch for the performance of systems. This is seen as a reassuring factor for those considering entering the market. A map of some of the BPL trial and commercial activity reveals the state of the market today:

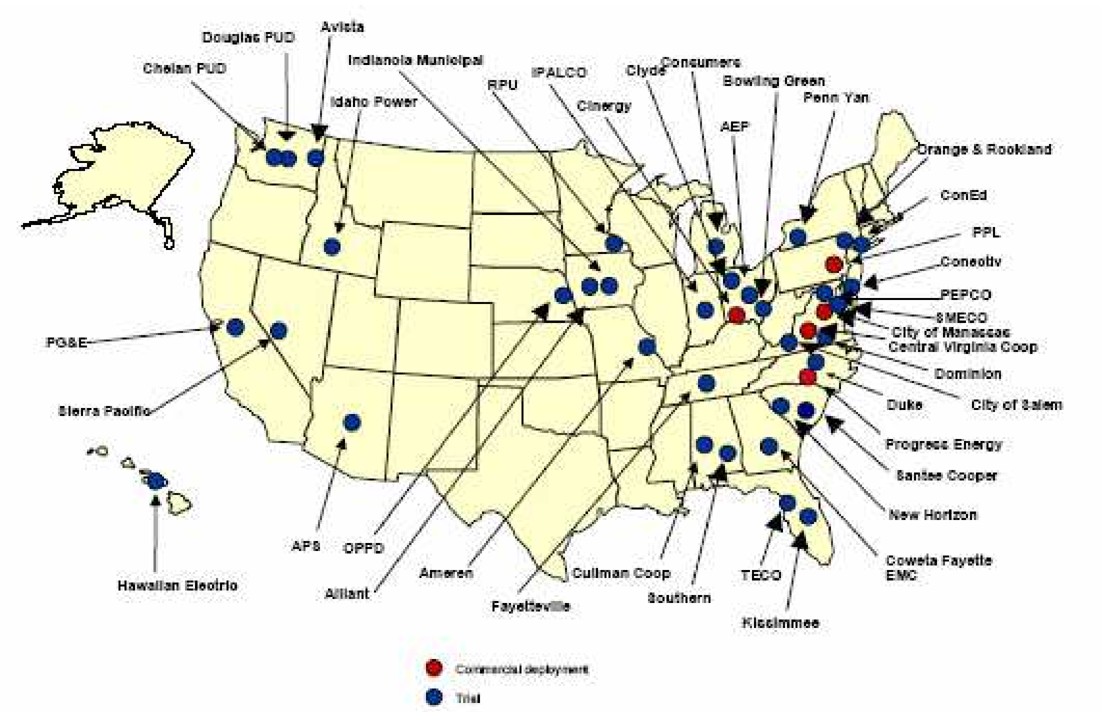


Figure 5-9 A map of some of the BPL trials and commercial activities in the USA

Follow is presented information about some USA electric companies:

- American Electric Power
- Southern Electric
- Consolidated Edison
- PPL
- Cinergy
- PEPCO
- Amerem
- United Telecom Council

5.2.3.2 PLC cases in USA

For any electric utility considering entering the BPL market, it is strongly advised that a properly constructed business case be developed. For example:

- Tier 1 (example: Minneapolis/St. Paul, MN). A hybrid wireless BPL system is most attractive in a dense metro market, where this model demonstrates positive net earnings within four years.
- Tier 3 (example: Syracuse, NY). As the market size becomes smaller, the classic system architecture dominates currently, especially in terms of earnings margins, which can exceed 60%.
- Tier 5 (example: Lynchburg, VA). In rural markets, capital costs for market entry can be minimized by deploying a cellular or modular system. By contrast, high capital expenses for a rural wireless-based BPL system result in a business case that is not attractive.

Further market-based conclusions for the BPL business case include the following findings:

1. Key demographics of the market can in fact differentiate the potential take rates that can be expected and should be studied prior to market rollout.
2. Density factors can drive the adoption of technology choice and can rule out some technologies as being financially unattractive relative to others.
3. The importance of bandwidth delivery will differ based on the demands of the market and the services being delivered.
4. Smart build. strategies should be employed whenever possible as a way to target sub-markets in an optimal order to maximize financial returns and minimize funding needs.

5.2.4 Technical Network Configuration and Equipment Suppliers

There are numbers of emerging BPL vendors in place today. In fact, a tally of potential providers of systems in place in North America today includes more than 30 when one considers the number of vendors in various stages of technology development. Eleven of the leading BPL systems vendors in place today are:

• Ambient (Newton, MA): employs primarily a classic architecture, with hybrid BPL only on the low-voltage side.

• Amperion (Andover, MA): uses a blend of power line and 802.11X wireless technology, with BPL providing the backhaul.

• Corridor Systems (Santa Rosa, CA): a relative newcomer, Corridor blends BPL with wireless technology, using the electric grid as a wave guide for wireless signal transmissions. Dead spots in the network are filled with distributed antenna systems.

• Current Technologies (Bala-Cynwyd, PA): employs a classic network design, with backhaul at the substation. Technology is Part 15 compliant.

• EBA PLC (Miami, FL): also a newcomer to the US, EBA can use either a classic architecture or a low-voltage design. Based on DS2 technology, EBA boasts very fast DSS5100 and DSS4200 chips at the head end and CPE and dynamic routing.

• GridStream (Fayetteville, TN): focused primarily on the rural market; its architecture is offered in two versions. The first uses 802.11 WiFi, and the second the HomePlug standard.

• International Broadband Electric Communications (IBEC) (Huntsville, AL): IBEC.s technology is very similar to that of GridStream; this company also as a rural focus.

• Main.net (Reston, VA): an active vendor, with architecture that can be divided into three domains: the Internet, the backhaul network and the BPL network. A technology in which the transformer is pierced, resulting in elimination of the need to bypass transformers.

• Mitsubishi (Sunnyvale, CA): new to the market, Mitsubishi is the first large company to compete. Equipment can be used in a traditional network or for in-building applications.

• PowerWan (Palo Alto, CA): a relative newcomer to the market, PowerWan offers very high bandwidth but requires significant fiber interface along medium voltage distribution lines.

5.2.5 Services offered and PLC-based Network Applications

5.2.5.1 Typical applications and services

This topic content: Statistics of Fixed Telephones, Cellular, Broad Band and Cable TV in the United States, Operators results to fixed telephony and CLECs.

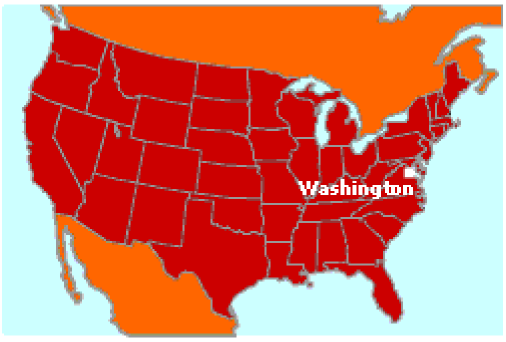


Figure 5-10 USA regional map

- Population (2004): 298.2 million
- Regulatory Entity: FCC
- Industry Association: CTIA and NCTA

The following graphic presents the evolution of public telephony and cellulars in the United States.

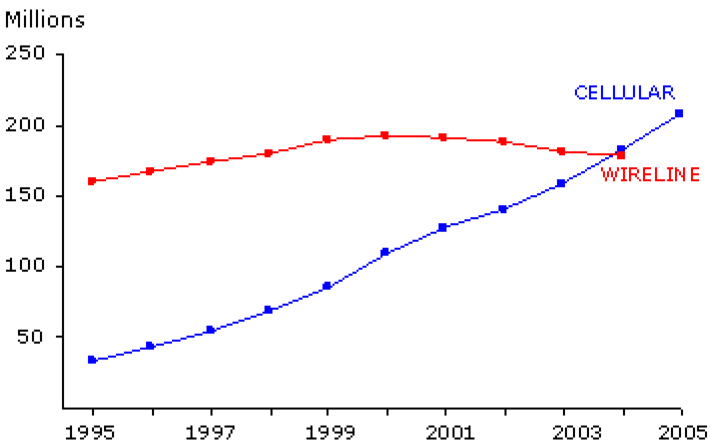


Figure 5-11 Evolution of public telephony and cellulars in the USA

Source: FCC and CTIA

In 2004, the number of cell phones surpassed the number of wireline, with 182 million cell phones and 178 million fixed accesses in service.

Broadband

Broadband Accesses (> 200 kbit/s in at least 1 direction):

Thousands	**2003**	**2004**	**2005**	**Jun/06**	
ADSL	9,509.	13,817	19,515	22,575	34.9%
Other Wireline	1,305	1,468	905	948	1.5%
Cable Modem	16,446	21,357	26,469	28,513	44.1%
Fiber	nd	160	448	700	1.1%
Satellite or Wireless	367	550	3,814	11,872	18.4%
Power line and others	-	-	5	5	0.0%
Total	28,230	37,353	51,156	64,614	100%

Table 5-10 Broadband access in the USA

Source: www.teleco.com.br

Fixed Telephony

Fixed Commuted Accesses in Service (thousands):

-	2000	2001	2002	2003	2004	2005	Jun/06
ILEC	177,561	171,917	164,386	153,158	144,810	143,766	142,250
CLEC	14,871	19,653	24,864	29,775	32,881	31,584	29,782
Total	192,431	191,571	189,250	182,933	177,691	175,350	172,032
CLEC	7.70%	10.30%	13.10%	16.30%	18.50%	18.00%	17.3%

Table 5-11 Fixed commuted accesses in service in the USA

Source: FCC

** Incumbent Local Exchange Carrier (ILEC) and Competitive LEC*

The number of fixed telephones in service got on the top in 2000, since then it is just have been decreasing. CLECs were growing until June/05 when it got 33,891 thousand, but it presented decrease in the 2Q06.

Public Telephony

In 1984 occurred the dismemberment of the AT&T in the United States with the formation of AT&T (Long Distance) and seven regional local telephony operators (RBOCs): Ameritech, Bell Atlantic, Bell South, Nynex, Pacific Telesis, South-Western Bell Corporation (SBC) and US West.

These operators, as the GTE are known as "Incumbent Local Exchange Carriers" (ILECs).

With the telecommunications deregulation in US appeared the "Local Competitive Exchange Carriers" (CLEC). In 2004 the CLECs had 32 million accesses: 57,7% were Unbundled, 16,5% resale and 25,9% proper ones.

The main ILECS are presented in the following table: Fixed Accesses in service (thousands).

-	Created by	2004	2005	1Q06	2Q06

Verizon	Bell Atlantic, Nynex, GTE	52,289	48,803	47,966	46,950
ATT (SBC)	SBC, Ameritech, Pacific Telesis	45,080	44,140	43,793	43,272
Bell South	Bell South	18,392	17,813	17,712	17,433
Qwest	US West	13,643	13,029	12,879	12,659
Sprint		7,443	7,139	N.D.	N.D.

Table 5-12 Fixed accesses in service in the USA

Source: Operators (Retail, do not include accesses given to other operators to resale or unbundling)

SBC acquired AT&T for US$ 16 Billions and changed the name to ATT inc. A fusion was approved in Nov. 2005.

Cable TV

	Thousands	**Thousands**
Cable TV Clients	Feb/06	73,904
Penetration of Cable in Residences with TV	Feb/06	66.3%
Digital Cable TV Clients	Sept/05	27,600
Broad Band Clients	Sept/05	24,300

Residential Telephony Clients	Sept/05	4,500

Table 5-13 Cable TV in the USA

Source: NCTA

Numerical Portability

In the United States is possible to change operators and keep the same telephonic number. The numerical portability for fixed telephone exists since 1999 and for cellular since November 2003.

The carried numbers are in a database that allows the aiming of the calls. In Dec/04 there were a total of 41,762 thousand numbers that had been carried, with 30,626 from fix to fix and 10,308 thousand from cellular phone to cellular phone.

5.2.5.2 VoIP service and IP telephony

VoIP Case:

Minacom and Sunrise Telecom Partner to Deliver Advanced VoIP and IPTV Testing Solutions

6:40 pm - September 12th, 2006

Minacom, the foremost service quality test automation supplier to telcos and cable MSOs, and Sunrise Telecom(R) Incorporated, a leader in testing and monitoring solutions for voice, video, data services and next-generation digital multimedia, announced today they will work together to provide integrated test solutions for telcos and cable Multiple System Operators (MSOs) offering VoIP and IP-Video services. The partnership will focus on combining the centralized test capabilities offered by Minacom’s DirectQuality(R) R7 service level test automation platform with the leading network and service test functionality available in Sunrise Telecom’s handheld FTTx, DSL, and cable test sets.

Sunrise Telecom’s handheld test sets are widely used by telcos and cable MSOs worldwide, as are Minacom’s test automation systems for VoIP and IP Video monitoring, installation and troubleshooting. By combining Minacom’s centralized test platform to validate VoIP and

IPTV service quality, and Sunrise Telecom's field experience with portable test instruments, service providers will be able to control tests remotely and review results from field-portable test sets.

VoIP test calls are placed by Minacom's PowerProbe(R) 6000 from a gateway's T1 or IP interface, through the providers IP/FTTx/DSL or PSTN network, directly to a 2-wire jack in a customer's home. This technique captures the full range of analog and IP/network impairments that commonly affect VoIP phone quality, including those introduced by copper/analog wiring, echo cancellers in network elements, and codec compression/decompression performed by telephone adapters and gateways; over 60 impairments are measured in under a minute, including MOS, echo, noise, loss, delay, touch tone (DTMF) transmission and fax connection performance.

IPTV, Video-on-Demand (VoD), and digital-media quality tests are conducted by a PowerProbe located in the head-end/super head-end, or video server farm. Providing true end-to-end service validation, the probe streams digital TV, HDTV, or VoIP-encoded RTP media traffic to Sunrise Telecom's handheld meters in the home or hub. Complete control over codec type, jitter buffer settings, packet priority and VLAN ensure that the wide array of measurements accurately reflect actual broadcast traffic quality.

Results from tests are centrally stored on Minacom's DirectQuality R7 server, featuring a web-based OSS used for reporting, service performance analysis and fault management, and automation for continuous service quality monitoring. With results stored on a centralized test server, field technicians and operations personnel can access current and historical test data from Sunrise Telecom's test sets, any Internet browser, or web-enabled mobile devices including BlackBerrys(TM).

5.2.5.3 Service Support and Utilities Applications

A significant attraction for many companies is the utilization of BPL for existing internal operations, since utility applications have been shown to pay for themselves quickly. While many utilities have focused on the promise of BPL from the perspective of delivering low-cost, bi-directional broadband services, many others have focused attention on an expanded list of potential utility applications that includes, but is not limited to:

1. Automatic meter reading
2. Capacitor control
3. Demand prediction
4. Distribution transformer overload analysis
5. Line testing
6. Outage localization and fault characterization
7. Phase loss detection
8. Power quality monitoring
9. SCADA delivery
10. Substation monitoring
11. URD outage diagnosis

In fact, financial modeling for five applications in a Tier-1 market involving automated distribution functions demonstrates the potential for financial performance through core utility operations; it is concluded that over $30 million per year in savings can be realized through implementation of a BPL system. In another real-life case study, substation monitoring demonstrated payback to a utility in less than two years. Thus, BPL represents opportunities to save money for utilities that are not interested in pursuing competitive business plans; in fact, the capabilities offered by such BPL internal applications may over time prove to be operating necessities due to more demanding state regulations.

5.2.5.4 The AMR Market

The AMR market in U.S.A. is growing up 24% to the year since 1997 (Metering International - www.metering.com) and the forecasts for the next 5 years is a growth of a 15% - 20%. In 2003, a research of the magazine Metering International, informed have more than 45,5 million units of AMR in operation in the world, and the technology based on radio was, the most used technology, followed for PLC short band. The Table 5-14 shows the research numbers.

Communication Technology	Units Shipped	# Projects
RF	34,483,073	3,290
PLC	6,945,640	816
Telephone	3,482,883	1,223
Mixed	634,713	65
Broadband	25,444	47
Misc.	4,465	15
Smart Card	2,000	1
Modbus	5	1
Total:	45,578,223	5,458

Table 5-14 World AMR

Source: Metering International magazine, 2003 - AMR is becoming an International Technology

AMR Cases:

- **Spokane, Washington,** – June 21, 2002 – Itron Inc. (NASDAQ; ITRI), a leading technology provider and source of knowledge to the global energy and water industries, today issued the following information and comments about market growth and financial performance in the wake of an analyst's report forecasting weakness in the market for automatic meter reading (AMR) technology.

Nosbaum said that in light of an analyst's report issued Thursday questioning the growth of the AMR market, as well as the sustainability of Itron's leadership role in that market, it's vitally important to draw on more comprehensive and objective industry data to see what's really going on in the AMR market.

According to the Scott Report on AMR Deployments in North America, a leading industry report, AMR unit shipments to utilities increased 40.2 percent from 2000 to 2001. That follows a 26.9 percent increase from 1999 to 2000, and a 12.7 percent increase from 1998 to 1999. Some 7.7 million AMR units were shipped in 2001 compared to 5.5 million units in 2000, according to the Scott Report. “That's a trend,” Howard Scott, author of the Scott Report, said Thursday. “There's no reason to believe anything is slowing down; it's actually speeding up.”

That trend is supported by Chartwell, a leading market research firm serving the utility industry. In its “AMR Report 2001,” Chartwell forecasts growth in excess of 15 percent over the next five years.

"These industry numbers reinforce what we're seeing at Itron," said Nosbaum. "Our growth numbers tend to be every bit as strong, if not stronger, indicating that Itron's position as the market leader remains solid."

Among the Itron highlights:

- In 2001 Itron shipped more than 2.9 million AMR meter modules, up from 2.2 million in 2000 and 1.9 million in 1999. That growth momentum continues as Itron shipped more than 850,000 modules in the first quarter of 2002 alone;
- Itron added 192 new utility customers that use Itron AMR technology during 2001, bringing the total number of utilities that have deployed Itron AMR systems to 871 at the beginning of 2002;
- Initial deployments of Itron AMR technology increased nearly 50 percent from January 2001 to January 2002. By comparison, initial deployments grew 46 in 1998, 87 in 1999, 54 in 2000 and 190 in 2001;
- As of March 31, 2002, Itron's total backlog stood at $202 million; with a twelve-month backlog of $112 million. In addition, bookings for the second quarter of 2002 are running ahead of the corresponding period in the first quarter of 2002.

"As these numbers demonstrate, demand for more advanced metering technology remains strong," said Nosbaum. "The strength of our core AMR business, combined with growth in our new business opportunities outside of AMR such as workforce management, data management and systems integration, as well as transmission and distribution system line design and services, reaffirms our guidance for strong financial results this quarter and this year."

TXU Electric , Texas

In the fall of 2006, TXU presented their vision of a smart grid network at an international IQPC PLC conference in Vienna, Austria:

- TRANSFORM existing power networks into high-capacity communications networks
- ENABLE scalable, integrated applications to enhance the grid functionality, tailored to each individual utility
- EMPOWER end users to control and manage consumption

A partnership was built with Current, an American PLC equipment supplier, who is designing, building and will operate the Broadband over Power Line network covering the majority of the TXU Electric Delivery service area including the Dallas-Fort Worth Metroplex and other communities. Current will provide retail, wholesale and other communications services to end-use customers, municipalities, and Internet Service Providers (ISP). TXU Electric Delivery will procure enhanced utility services such as automated meter reading (AMR) communications, fiber optic data transport and network monitoring services from CURRENT. This was the most significant BPL project in the USA, and may cover up to 2 million AMR meters. The initial smart grid applications are: (1) AMR, (2) Distribution Networking Monitoring, (3) Outage Notification and (4) High speed data transport.

For this project, the traditional vendor/supplier relationship was replaced by an integrated collaborative relationship. The following milestones have been achieved to date (September 2007):

- 111.000 homes have been passed
- Overhead and underground construction is underway
- 99.000 meters have been installed at customer sites
- billing of customers is taking place via AMR meter reads
- dispatch ops. resources are based on BPL data

Higher order functionality in residential meters, ramp-up of underground installations, outage notification and validation are well underway today.

PLC and New Fixed RF AMR Solutions Experience Market Growth

Power line carrier (PLC) and new fixed radio frequency (RF) automatic meter reading (AMR) solutions are attracting the attention and investment dollars of utilities in the power as well as the gas and water markets. Utilities are keen to consider new AMR solutions that not only support time-of-use and/or critical peak pricing but are also less expensive than the earlier fixed RF AMR solutions.

This Frost & Sullivan research segments the North American AMR market into advanced metering AMR and basic AMR based on the capability of the solution to provide interval usage data. The study provides two forecasts for the electric AMR market, one assuming the current economic outlook and the other assuming a more optimistic outlook.

Electric Industry Turmoil Spurs Utilities to Increase Operational Efficiencies

"New market drivers have emerged as a result of the need for utilities and end-use customers to avoid the risks associated with the restructuring of the electric market," says the author of the study. Hourly data from the advanced metering AMR solution can provide utilities with data to support retail rates that send a strong price signal to customers to reduce usage during periods of relatively high wholesale energy prices. This will help utilities mitigate the volume and price risks created by the restructuring of the energy market.

The elevated interest in interval usage data for the small end-use customers and the emergence of new AMR technologies that are reliable and less expensive should spur market growth in advanced metering AMR solutions. However, the industry turmoil can limit market growth as a result of the financial difficulties facing many investor owned electric utilities. They are not in a position to invest in AMR due to losses incurred by wholesale energy trading, and worsened by the decline in the volume of trade.

Economic Outlook and New Products Impact Revenue Growth Potential

Projected revenue growth for advanced metering AMR is strongly dependent on the assumed economic outlook. Under the current economic outlook, utilities are expected to settle for basic AMR. If conditions are more favourable to capital investment by utilities, as assumed in the optimistic outlook, utilities are expected to favour advanced AMR. BPL has started to be seen as the most affordable technology to build the networks needed to create smart grids.

5.2.5.5 Service Providers

The Table 5.1.5 below shows the main AMR service providers for utilities, the used network technology and the country.

Provider	Network technology	Country
Itron http://www.itron.com/pages/index.asp	Radio Frequency, Cellular, PSTN, Power Line	Word
Echelon http://www.echelon.com/	Optic Fiber, Radio Frequency, Power Line	World
Enermet http://www.enermet.com/en/	GSM, PSTN and Power Line	World
TWACS http://www.twacs.com/	Power Line	Estados Unidos
Telvent http://www.telvent.com/	Optic Fiber, Radio Frequency, Power Line	World
Elster http://www.elstermetering.com/en/	GSM	World
Shpliger Group http://www.shpigler.com/	Power Line	United States and Canada
Logger AMR http://www.logger.com.br/beta/br/solutions/solutions.htm	GSM	United States and Latin America

Table 5-15 AMR service providers

5.3 Eastern Europe

5.3.1 Region covered

Eastern European countries treated in this report will be the following:
Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Turkey and Ukraine.

Figure 5-12 Eastern Europe

5.3.1.1 Electrical coverage

Although many countries of the Eastern Europe area have a similar (and sometimes a common) past, from the point of view of the infrastructures their situation can significantly vary. For this reason, the condition of the electric infrastructure will be separately described for every country (as the telecommunication condition) [E32].

Albania

Albania’s infrastructure is far below the standards of other European countries.

Albania's power system has 1,670 megawatts (MW) of installed capacity, of which 1,446 MW is in hydropower plants (the country's mountainous terrain is favorable for that type of power) and 224 MW in thermal plants. A quarter of the energy is lost due to technical inadequacies, and blackouts are still frequent. Often, electricity reaching consumers is not paid for (70% of the clients refused to pay their bills in 1997). A particular concern is the theft of electricity by bypassing meters. The power utility, Korporata Elektroenergjitike was scheduled for privatization in 2001. A loan of US$30 million from the World Bank, US$12 million from Exportfinans of Norway, and US$1.2 million from the Chinese government helped Albania repair its electric grid in 2000.

Belarus

Belarus has an extensive though aging infrastructure, which is badly in need of investment for repair and maintenance.

Belarus remains highly dependent on imported energy and has made little progress toward diversifying its exports and entering new markets. Many energy consumers, such as households, businesses, and even government offices, have not been able to pay their utility bills. The government attempted to pay its debts by bartering and through agreements directly with Russia and Lithuania. Even though the large majority of electricity and fuel is imported, there is some domestic production of energy.

Bosnia and Herzegovina

The country's infrastructure, including highways, railroads, and communication networks were severely damaged by the war.

Electricity is produced in coal burning (32%) and hydroelectric (68%) plants. Because of the war, electricity-generating capacity declined by four-fifths. Most hydroelectric plants are in the Croat-controlled area. Therefore, close cooperation across Muslim-and Serb-held territory is essential for power distribution. Electricity prices vary substantially, with the Serb

Republic subsidizing them heavily within its area. Hydropower Tyrol (Austria) is investing US$6 million in the Federation's 4 hydroelectric facilities.

Bulgaria

Bulgaria's energy sector is state-owned and derives most of its output from thermal plants burning fossil fuels, mostly coal and natural gas (52%), nuclear plants (41%), and hydroelectric facilities (7%). Newer units of the Kozloduy nuclear plant will be upgraded under a contract between the National Electric Company and the U.S. company, Westinghouse. Bulgaria exports energy, primarily to Turkey and Yugoslavia.

Croatia

Judged by Eastern European standards Croatia has a comparatively well developed infrastructure.

Croatia's demand for electricity is mostly satisfied by domestic production, while 10 to 20 percent is covered by imports. The country produces most of its electricity from fossil fuel and hydroelectric plants. A small portion comes from the nuclear plant Krsko, which Croatia shares with neighboring Slovenia.

Czech Republic

The Czech Republic's electricity production stands at 61.5 billion kilowatt hours, and the country uses a 220-volt power system. The majority of electricity is generated by fossil fuels (76%). While a portion of this production comes from coal, oil provides a sizable portion as well and is imported from Russia. Nuclear power contributes 20% of electricity production.

Estonia

Estonia's 2 oil-shale power plants produce twice what is consumed domestically. Under Soviet rule the country exported energy to Russia and Latvia but these markets dried up after independence. The government is forming a joint venture with the American NRG Energy company to renovate and operate the plants, bringing them into line with international environmental standards, and its priorities include creating an energy connection to western European electricity grids via an undersea cable.

<u>Greece</u>

Electrical power in Greece is supplied by lignite-fueled power stations (lignite is a type of coal). Hydro-electric power is also used. Solar energy and wind power are being considered as alternative energy sources. Natural gas is becoming a popular alternative to coal for electricity production. The gas comes from a pipeline shared by Greece and Russia and is considered more environmentally friendly and efficient than coal. In February 2000, the Ministries of the Environment, Natural Planning, and Public Works signed an agreement to replace coal with natural gas. Natural gas is a new energy source in Athens, and many homes and businesses are beginning to use it. Another benefit is that natural gas would reduce the high smog levels in Athens.

<u>Hungary</u>

Power production in Hungary relies on a combination of domestically generated energy sources and imports. Hungary still has artificially low subsidized energy prices, but there are plans to allow prices to rise to western European market levels. At present Hungary's energy prices are between one-third and one-half of the prices in EU countries.

Like many other former Eastern bloc countries, Hungary relies heavily on fossil fuels to meet its energy needs. Hungary's estimated sources of primary energy supplies were 16.9% coal, 27.1% oil, and 40.4% natural gas. Nuclear energy is produced in Hungary's nuclear power plant, located near the city of Paks. Nuclear energy provides 38.9% of Hungary's electricity production.

<u>Latvia</u>

Oil and gas are imported into Latvia from Russia and help to fuel industries and the 2 thermal power plants near Riga. In addition, 3 hydroelectric dams along Latvia's largest river, the Daugava, add to the power supply, but still electricity is imported to feed this most industrialized Baltic State.

Lithuania

Lithuania was in the midst of constructing a power line to supply electrical exports to the West. Some 13% of the electricity came from fossil fuels and 4.3% came from hydroelectric sources, but the overwhelming majority, 82.61%, came from nuclear power plants.

Lithuania's energy sector needs modernization as well. Post-Soviet Russia's supply network is unreliable and subject to political manipulations resulting in cuts of oil to Lithuania. The opening of the Butinge oil terminal on the Baltic Sea in 1999 allows Lithuania to diversify its supply of crude oil by sea. Currently, the nation has about 10 million barrels of proven oil reserves. Other sources of power, such as Ignalina nuclear power plant (of the Chernobyl type), are controversial for safety reasons. Electric power generation needs to be modernized and privatized, while new and profitable supply networks to Western Europe via Poland need to be established. Lithuania's power complex experiences substantial problems with generation, distribution, and sales. The capacity in the system is about 2 to 3 times higher than the national demand for power generation and gas distribution. As a result of inherited Soviet-style inefficiencies, losses amounted to about one-third of supply and were made worse by non-payment of debts by some clients, for example, in Belarus.

Macedonia

Macedonia has only 10 kilometers of oil and gas pipelines. The energy sector is state-owned and produced electricity in thermal plants (85.37%) and hydro-electric facilities (14.63%). Privatization was planned for ESM, the national electric utility, and in September 2000 the government began passing it into shareholder ownership.

Moldova

Moldova's electricity production is generated for the 93% in thermal plants and for the 7% in hydropower facilities. Domestic sources account for 2% of primary energy supply. A large gas power plant in Transnistria produces 85% of the electricity.

Moldova remains reliant on Russian gas, and Gazprom periodically cuts off supplies due to chronic non-payment, as do Romania, Ukraine, and Transnistria for unpaid electricity.

Mounting bills result from non-payment by consumers, electricity theft, and wastage. The sector has been restructured into 2 generators and 5 distributor companies, and in 2000, Moldova completed the first round of electricity privatization, selling 3 of the distributors to Union Fenosa of Spain.

Poland

About 95% of the country's electricity is generated by burning fossil fuels. Public opposition in the early 1990s put an end to the construction of a proposed nuclear power plant in Zarnowiec, which was converted to conventional fuels instead. Hydroelectric power is also generated, mostly in southern Poland, where the mountainous topography offers opportunities to construct dams. Since much of the country's terrain consists of open plains, there is some expectation of being able to harness wind power in the future.

Romania

Investment into Romania's energy sector is badly needed. The country generates its power from a combination of thermal, hydro-electric, and nuclear power plants. But most of the plants are over 20 years old, and about 60% of Romania's power capacity will have to be replaced within the next 5 years. The power market is dominated by the state monopoly Conel. To meet EU expectations and attract investment into the power market, Romania plans to liberalize the power market, break up Conel, and privatize parts of the sector. The government is also pushing for an oil and gas pipeline to be built through the country to transport fuel from the Caspian Sea region to the West. But with several countries competing to become a transit route, the outcome is uncertain.

Russia

Russia's overall electricity production is produced for the 69% through burning fossil fuel, 20% results from hydroelectric generation, and roughly 13% is produced at commercial atomic generating stations.

Effective wholesale gas and electricity tariffs have been at only around one-tenth of the Western European level for the past decade, with the ratio even worse in distribution to households. The problem has been exacerbated by low rates of cash collection. In the power sector, cash collection rates stood at less than 20% in 2000. Due to its financial unattractiveness but also due to the lack of an appropriate legal and regulatory framework to facilitate private sector participation, infrastructure services are generally provided by state and local government-owned entities. Progress in the corporatization (turning utility systems into corporate entities) and commercialization of infrastructure has been poor. There has been some separation of publicly-owned service providers from government, transforming them into legally autonomous corporate entities. However, there continues to be a high degree of government (federal, regional, and local) interference in their management and financial operations.

Slovakia

Electricity production stands at 20 billion kilowatt hours (kWh), and the country relies on a 220-volt power system. Most electricity is generated by nuclear power (56%), followed by imported fossil fuels (24%) and hydroelectric power (20%). One of the 2 nuclear plants was being upgraded as of 2000, and the construction of an additional hydroelectric power plant on the Danube has been delayed by a dispute with Hungary.

Slovenia

Slovenia's energy sector is state-owned and derives most of its output from nuclear plants (38.2%), thermal plants burning fossil fuels (37.1%), and hydroelectric facilities (24.7%). Slovenia also exports some energy. The German Siemens and the French engineering group Framatome have won a $38 million contract to replace 2 steam generators at the Krsko nuclear power plant, jointly owned by the Slovenian and Croatian electricity companies. American-owned Westinghouse has also announced its contracts to supply fuel assemblies to the plant.

Ukraine

In the Soviet period, Ukraine was a net exporter of electricity both to former Soviet states, and to Eastern Europe. After independence it became a net energy importer. According to the World Bank, the electrical power consumption per capita in Ukraine has drastically declined, from 4,308 kWh in 1990 to 2,449 kWh in 1997. With about 60% of Ukraine's electricity generated by fossil fuels (the remaining 40% being produced by nuclear and hydroelectric plants), this production decline has been exacerbated by problems in obtaining natural gas, oil, and coal supplies, mostly imported from Russia, who also provides Ukraine with nuclear fuel, for which Ukraine currently owes Russia $800 million.

Ukraine's 5 nuclear power plants, with a capacity of 12.8 giga-watts (nearly one-quarter of the country's total capacity), generate around 70 billion kWh of energy (more than 40% of the country's power output). The construction of 2 new reactors (capacity 2 gigawatts) is in its final phase. In June 2000, Ukraine's nuclear power plants generated more than half of the nation's total electricity output, the first time that has happened since 1996, despite the fact that 5 of the nation's 14 nuclear reactors, with 24% of national capacity, were inactive in June. The 1986 Chernobyl nuclear accident cast serious doubts about the safety of nuclear reactors in Ukraine and their ability to meet the long-term power needs of the nation.

Another factor which has harmed the nation's electrical sector, next to import and capacity problems, has been the growing number of defaulting electricity consumers. About 35% of Ukrainian families received their electricity free by law. Largely as a result of this situation, the Ukrainian Ministry of Power Engineering and Electrification has described itself as bankrupt.

<u>Serbia</u>

Serbia enjoys a central location in the Balkans, but the loss of markets and economic sanctions and NATO's bombardment in 1999 devastated the transportation and communications sector: billions of dollars are needed for repair and modernization.

Before 1999, the country was self-sufficient in electricity from coal and hydropower. The sector is dominated by the state-owned monopolies of Serbia and Montenegro. The bombing in 1999 destroyed or damaged 14 power stations and 2 major oil refineries.

[E33] Of the ten countries which joined within the European Union in 2004, five (Czech Republic, Hungary, Lithuania, Slovakia and Slovenia) have operating reactors. Both Bulgaria and Romania, which joined in January 2007, also have nuclear reactors. In some cases, shutting existing older Soviet-era reactors was a condition of EU entry, but these countries retain a strong interest in nuclear and several have firm plans for new reactors in the future. The contrast between this wealth of activity in Eastern Europe and the lack of positive nuclear plans further west is indeed striking. It has several explanations. Certainly, these countries are already benefiting economically from EU membership and electricity demand is rising rapidly. In itself, this brings with it consideration of energy policy and the available generation alternatives. Having just broken free of economic dependence on Russia, none wants to imperil energy independence by relying upon Russian oil and gas, nor import large quantities of power from neighbouring countries. The economic benefits of nuclear are also appreciated as the countries are proud of the operating performance of their older reactors.

Finally, in Appendix A, the first table shows the last data on the electricity production of the Eastern European countries.

5.3.1.2 Telephone coverage

A brief description of the telephone coverage follows. [E32].

Albania

In Albania the telephone system is obsolete, with 42,000 main lines in 1995. In 1992, rioting peasants cut the wire to about 1,000 villages and used it to build fences. There were 3,100 mobile phones in 1999, with coverage limited to the main cities. In 2000, the privatization of the mobile phone company, Albanian Mobile Communications (AMC), was completed, and the sale of the fixed-line operator, Albtelekom, was set for 2001. A consortium of Vodafone (UK) and Panafon (Greece) won a mobile telephony license in early 2001 for US$38 million.

Belarus

Telecommunications services in Belarus are inadequate for both public and business use. Hundreds of thousands of applications from household telephones remain unsatisfied. Some investment on international connections and businesses has taken place, much of it in

Minsk. A domestic cellular telephone system operated in Minsk, but only 1 person out of 1,000 owned a cellular phone in 1998. By 2000, the country had 9 internet service providers. However, the number of personal computers in the country was very low.

Bulgaria

Bulgaria has the highest penetration of telephone service in Eastern Europe, at 38.47%. The network is operated by the state-owned Bulgarian Telecommunications Company (BTC). In 1998, it replaced antiquated facilities with up-to-date equipment and connected major cities with digital exchanges, satellite ground stations, fiber-optic lines, and digital microwave networks in a $300 million project funded by international investors. Residential telephone development will reach EU standards by 2008. There is analog cellular telephone network operated by the Mobifon company. The Bulgarian company, Mobiltel, operates a digital cellular telephone network, and the country has many small, unregulated, internet service providers.

Croatia

Telecommunications services in Croatia are modern, although they lag behind those of Western Europe and the United States. Telephone service is provided by Croatian Telecom (HT), which has invested heavily in improving telecommunications. Although some domestic lines are still analog, they are being replaced by digital technology with a capacity of 2,200,000 telephone lines. The international telephone service is completely digital, and its main switch is located in Zagreb. A project is under way to install fiber-optic cables throughout the country and connect them with Slovenia. Currently there are 220,000 kilometers of fiber-optic cables connecting 4 main Croatian cities and 35 countries.

Czech Republic

The Czech Republic has a rapidly-modernizing communications infrastructure. In the first few years after the transition from communism, the installation of telephone lines by the state company was still difficult. However, the increased entry of private telecommunication companies and the growing popularity of mobile telephones has provided a way to sidestep these difficulties, and increased competition has forced the Czech telecommunications company, STP Telecom, to improve its service. Internet cafes are readily available, and the Czech government has taken steps to promote increased public computer and internet technologies.

Estonia

The telecommunications market in Estonia is among the most liberalized in Eastern Europe. In 1998 a 49% stake in the state-held Eesti Telekom was sold to a consortium of state-controlled Telia (Sweden) and Sonera (Finland), and the government was considering selling the remainder of its stake in the company. Modern phone lines extend throughout Estonia. There are 3 mobile phone service providers: Eesti Mobiiltelefon (a subsidiary of Eesti Telekom), Radiolinja Eesti (a subsidiary of Finland's Radiolinja), and Ritabell (a joint venture between the British Millicom International and local Levi-com). Estonia has the highest number of mobile phone users per capita in Central and Eastern Europe. Eesti Telefon, the fixed line division of Eesti Telekom, had a monopoly in domestic and international fixed line calls until 2001. Estonia has one of the highest numbers of internet subscribers in Eastern Europe, and the government intends to provide all schools with internet access.

Greece

I Greece, communications are modern. The country's telephone system is adequate, with networks reaching all areas for main telephone lines and mobile cellular phones. Most telephone calls are carried by microwave radio relay. Underwater cables transmit calls to the Greek islands. Computers and communications are increasing in popularity and availability.
During the 1980s, the government dissolved its monopoly on radio and televisions stations. Many private television and radio stations emerged, as well as European satellite channels. By early 2001, however, the Greek government moved to shut down dozens of the popular privately-owned radio stations, saying that their proximity to the new Athens airport could cause radio interference. The announcement was widely condemned by opposition parties and media unions, as well as large numbers of loyal listeners.

Hungary

Hungary's telecommunication network has until recently been underdeveloped both from a technological and a service standpoint. But partial privatization of the state telephone company Matáv in 1993 and the planned introduction of competition for land-based telephone lines in 2002 has led to many important changes. Among these has been a spectacular growth in cellular phone services and ownership, with the number of mobile phone subscribers estimated at more than 3 million in 2000. There were 3 companies providing cellular service in 2001.

Under communism the telecommunication system was underdeveloped and poorly operated. Even in the first half of the 1990s, Hungarians often had to wait more than a year to have a fixed telephone line installed. This situation has changed quickly in recent years, however. The domestic phone network is now digitized and highly automated and is able to provide almost any telecommunication service need. Trunk services are carried by fiber-optic cable and digital microwave radio relay. Hungary has fiber-optic cable connections with all neighboring countries. Internet activity has also grown significantly in Hungary.

Latvia

Privatization has caused a reconstruction in Latvia's telecommunications network. In 1994, 49% of the system was sold to a British-Finnish telecommunications consortium and international communications became available at standard international rates. The privatized telecommunications company, Lattelcom, is working toward a fully digitized network by 2012, thus alleviating the problem of unmet demand due to a shortage of lines.

Lithuania

The telecommunications market in Lithuania is liberalized since 2002, when the fixed-line telephony Lietuvos Telekomas terminated its monopoly. A national fiber-optic cable system is nearing completion, and rural exchanges are being improved and expanded. Mobile cellular systems are functioning and rather widely accessible. Access to internet is growing, and by 1999, there were 10 internet service providers.

Macedonia

The monopoly of the state-owned Makedonski Telekomunikacii (MT) ended in 2001. Growth in demand for transport and telecommunications services reflects the continuing logistical requirements of the international operations in Kosovo. The deployment of the North Atlantic Treaty Organization (NATO) peacekeepers and the UN Interim Administration Mission in Kosovo in 1999 required huge spending on transportation, energy, and telecommunications (as did the presence of the UN preventive deployment force in 1993).

On June 2007, the government announced to have planned the opening of free, state owned internet café's in the major towns across the country by the end of the year. The aim of the government is to enable access to the internet, mostly to the young people (up to 26) and to people who cannot afford internet anyway (people over 64 years old).

Moldova

Moldova has an antiquated telephone system, very few pay phones, many villages without service, and a very low mobile phone penetration rate. Moldtelecom, the national telecom, is currently upgrading and has signed agreements with Denmark's Great Northern Telegraph (GNT), which is investing $10 million in a digital switch system and fiber-optic technology. The government intends to sell 51% of Moldtelecom following a failed attempt at privatization in 1998 to a Greek company. In 1998, Voxtel, a consortium comprising 1 French, 1 Romanian, and 2 Moldovan companies, launched mobile service in the GSM standard. In 2000, Moldova awarded a second GSM license to Moldcell, a joint venture between Turkish Turkcell and Chişinaˇu-based Accent Electronics.

Poland

Telecommunications services are undergoing rapid modernization. After years of neglect, new switchboards are constantly being installed and the number of telephone subscribers has increased substantially. The nation has enthusiastically adopted wireless communications and cellular phones.

Romania

Romania's telecommunications system is extremely outdated, with poor service. But there has been some progress in recent years. In 1998, Greece's OTE bought a 35% stake in the state fixed-line monopoly, Romtelecom. OTE plans substantial investment, while the government has raised US$7 to 8 billion through a 15-year telecoms program supported by the World Bank and the European Bank for Reconstruction and Development. Meanwhile, mobile telecoms have grown rapidly, led by private companies such as Mobifon and Connex. Over 1 million Romanians are now thought to have mobile phones, with 60% of the country covered. Internet access has been slow to develop because of poor phone lines.

Russia

Russia's telecommunications system is in the midst of the global telecommunications revolution. The country's phone system has undergone significant changes since the breakup of the state phone monopoly in 1990. By 2000, there were over 1,000 companies licensed to offer communication services. During this period access to digital lines has improved, particularly in urban centers. Internet and e-mail services are now widespread and rapidly improving. In a few short years, Russia made significant progress toward building the telecommunications infrastructure necessary for a market economy. Cross-country digital trunk lines run from Saint Petersburg in the northwest to Khabarovsk in the Russian Far East and from Moscow in the country's European center to Novorossiysk in the south. The telephone systems in over 60 regional capitals had installed modern digital infrastructures by 2000. Cellular services, both analog and digital, expanded rapidly in 2000 and 2001. Three undersea fiber-optic cables connect Russia to the international phone system. Digital switches in several cities provide more than 50,000 lines for international calls. Satellite earth stations provide access to Intelsat, Inter-sputnik, Eutelsat, Inmarsat, and Orbita.

Slovakia

Slovakia's communications infrastructure is rapidly modernizing. In 2000, Slovak Telecom, the former state-owned communications monopoly, was largely privatized, and access to telephone service is easier. The increased entry of private telecommunications providers and the growing popularity of mobile telephones now provide more competition in this industry. Internet cafes are readily available, which make up for the fact that relatively few Slovak households contain computers. Slovakia also lags behind the Czech Republic in the proportion of radios and televisions but is on a rough par with Poland in these categories.

Slovenia

In communications, Slovenia has been at the leading edge of the internet revolution, with the highest concentration in Eastern Europe of internet connections per inhabitant (and per server), and it offers a promising ground for emerging electronic commerce players. It has a well-developed modern telecommunications infrastructure and ranks second in Eastern Europe, after Hungary, in terms of cellular telephone penetration and telephone density is 36%. A second cellular service provider, Simobil, a joint venture between Telia of Sweden and 8 Slovene companies, that is using the pan-European Global System for Mobile Communication (GSM) standard, has recently joined the leading cellular company, Mobitel. In traditional telecommunications, the national monopoly, Telekom Slovenije (ST) retained its fixed-line monopoly until 2000. Slovenia's ambition is to become a transit area for Balkan communications connections and talks are under way with several countries in the region. Competition in this area, however, may come from Hungary.

Ukraine

An expanding array of tele and radio communications are increasingly available and constantly improving, and new joint venture companies provide modern technology development in this sphere.

Serbia

In 1997, the purchase of a 49% share of the Serbian Telecommunications Company PTT by the Italian company Stet and Greece's OTE pumped nearly US$1 billion into the budget. War and sanctions delayed modernization, but this has led to fast mobile telephone growth. Access to the internet was introduced in 1997, and there are about 100,000 registered users and 150,000 personal computers.

Recent data about the number of telephone main lines, mobile cellular and internet users for every Eastern European country are shown in Appendix A.

5.3.1.3 Other coverage

As regards the general situation of the access to the information in the various Eastern European countries, such as the availability of fiber and satellite links, please refer to the tables in Appendix A.

5.3.2 Regulatory Situation (PLC Networks and Equipment)

5.3.2.1 Overview

[E35] On January 1, 2007 Bulgaria and Romania joined the EU, which has now 27 Member States. In accordance with the EU accession commitments, Bulgaria and Romania had to complete the transposition of the EU 2003 electronic communications regulatory framework by January 1, 2007. This formal requirement was met only by Romania. In terms of practical implementation, both countries still have to address a number of issues in the field of electronic communications in order to achieve compliance with the EU rules, including implementation of fixed and mobile number portability.

Public tender procedures for the nation-wide assignments of BWA spectrum were completed in Bulgaria in the 26 GHz band and in Estonia in the 450 MHz band. A further public tender procedure for regional BWA licences in the 3.5 GHz band is underway in Croatia. Regulators in Macedonia, Poland, Romania and Slovakia have launched consultations on BWA spectrum covering several available bands.

In Bulgaria, the legislative process of adopting the new Electronic Communications Act transposing the EU 2003 regulatory framework into the national law is moving rather slowly.

On September 20, 2006 the National Assembly of Bulgaria had the first vote on the draft Electronic Communications Act. Subsequently, the draft was returned to the leading parliamentary committee for Transport and Communications for implementation of amendments and clarifications requested by the parliament. The second vote in the National Assembly was planned for February 15, 2oo7.

Romania was one of the first countries in Europe to adopt already in 2002, and on its own initiative, national legislation that is based on the EU 2003 regulatory framework. Since then the Romanian regulator has been carrying out an analysis of relevant markets as foreseen by the EU framework, although without the requirement to notify its draft market analysis decisions to the Commission and other NRAs under article 7 of the Framework Directive.

On September 13, 2006 the Romanian government adopted Government Emergency Ordinance No.70 on "amendment and completion of certain normative acts in the field of electronic communications and of postal services". The new ordinance creates a mechanism, applicable once Romania joined the EU on January 1, 2007, for the notification to the Commission and other NRAs of the market analysis decisions adopted by the Romanian NRA. At this stage, however, it is not yet know when the Romanian NRA will start notifying the results of the market analyses to the Commission and other NRAs under article 7 of the Framework Directive.

On January 30, 2007 the president of the Republic of Poland approved amendments to the Telecommunications Act that were adopted by the Sejm (the lower house of the Parliament) on December 8, 2006 and by the Senate (the upper house of the Parliament) on December 21, 2006. The amendments cover procedural matters regarding allocation of spectrum rights and the fees for these rights under. In particular, the provisions are intended to clarify the rules for assigning spectrum rights following a public tender procedure. Another set of amendments to the Telecommunications Act is also currently under preparation. In September 2006 the government announced that the process of inter-ministerial consultations had begun.

In Bulgaria, on December 14, 2006 CRC adopted Resolution No 2247 granting five national BWA licences to operate national point-to-multipoint networks in the 26 GHz band, valid for 15 years. Licences were issued to five operators that submitted bids on October 27, 2006: the incumbent operator BTC, mobile operator Cosmo Bulgaria Mobile, as well as three alternative operators Max Telecom, TransTelecom and Nexcom Bulgaria. Two of the licensees, TransTelecom and Nexcom, already own BWA licences in the 3.5 GHz band. Since the five bidders applied only for 20 duplex channels out of the total 25 channels available in the invitation to tender published in September 2006, CRC decided to grant individual licenses to all five bidders without any competitive procedure.

In Croatia, on November 29, 2006 CTA decided to withdraw from Iskon internet, a major ISP, the frequency concession for BWA services in the 3.5 GHz band covering the Zagreb county region following the acquisition of Iskon internet by the incumbent operator T-HT. The concession for the 2x21 MHz spectrum block in question was awarded to the alternative fixed operator Optima Telecom, which was the second best ranked company and received a smaller 2x14 MHz spectrum block in the original beauty contest procedure for four FWA concessions in March 2006. This 2x14 MHz block was in turn awarded to the mobile operator VIPnet that was ranked number five in the original procedure and did not receive any frequency concession at that time. On December 27, 2006 CTA announced a beauty contest procedure for FWA frequency concessions in the 3.5 GHz in a single region covering four neighbouring counties: Krapina-Zagorje, Varaždin, Koprivnica-Križevci and Virovitica-Podravina. Interested operators were invited to submit their bids. So far, CTA has issued 42 concessions for FWA spectrum in the 3.5 GHz band covering 10 out of 20 Croatian counties and the District of Zagreb. Each concession has a 5 year validity period with the spectrum fees varying, depending on the region.

In Estonia, on November 6, 2006 ENCB announced Televõrgud, a fixed telecommunications operator controlled by the state-owned Estonian Energy Company, the winner of the tender procedure for the national BWA frequency licence in the 450 MHz. The tender procedure was launched by ENCB on June 19, 2006. The licence allows both fixed and mobile BWA applications, but requires the data transmission speed to be at least 144 Kbps.

In Macedonia, on December 4, 2006 AEC announced its intention to launch a public tender procedure in the first half of 2007 for granting spectrum authorisations in the 3.4 - 3.6 GHz band for provision of FWA services. A working group has been established by AEC. AEC has also sought approval from the government on the market value of the radio frequencies to be recovered as a one-time fee for the FWA spectrum authorisations. Following the expressions of interest from potential service providers, AEC published in April and July 2006 two documents concerned with the introduction of FWA: “Guidelines for technical and exploitation conditions for radio frequency utilisation in the 3.4 - 3.6 GHz frequency band for

FWA" and "Guidelines for introducing FWA in the 3400-3600 MHz frequency band in the Republic of Macedonia".

In Poland, Romania and Slovenia, in December 2006 UKE consulted on the future use of spectrum for BWA applications based on point-to-multipoint systems in three spectrum bands: 3.6 - 3.8 GHz, 2200 - 2400 MHz and 2500 - 2690 MHz. In particular, the UKE addressed the following issues:

- whether these bands should be allocated to BWA applications on a technology-neutral basis or should be reserved for any specific standards and technology solutions, such as TDD or FDD.
- compatibility with other uses.
- assignment methods (local, regional or national networks).

On January 10, 2007 the UKE published a summary of the received responses. Following two public tender procedures held in 2004 and 2005, six national licences were granted to four operators: the mobile operator PTC and three fixed operators Netia, NASK and Clearwire (two licences each of 28 MHz, and 4 licences each of 14 MHz). Still available in this band are 12 duplex channels of 3.5 MHz each. In 2005 URTiP (the predecessor of UKE) organised tender procedures for 317 local licences in this spectrum, each covering areas of the administrative units called powiats. A review conducted by UKE during 2006 showed that most of the offers submitted during this tender were incorrectly assessed. Consequently, UKE decided to annul all 317 procedures and to resume the discussion on the future use of this spectrum. According to the national frequency allocation table, this band is foreseen for civil applications allowing both fixed and mobile services. The UKE is now consulting on possible uses of these frequencies.

At the EU level the use of this band (so called "UMTS expansion band") is regulated by ECC Decision 05 of March 18, 2005 containing a channelling plan for harmonised use by terrestrial IMT-2000/UMTS services and to facilitate cross-border co-ordination and efficient use of spectrum across Europe.

In Romania, seven operators hold ten national fixed wireless access licenses, while five operators hold 175 local licenses in the 3.5 GHz band. IGCTI stated that it expects the first WiMAX services will be available in Romania already in 2007. On November 28, 2006 the

Ministry of Communications and IT (MCTI) also held a public discussion on drafting the strategy for granting spectrum licences that would enable the introduction of WiMAX services. On November 7, 2006 IGCTI published for consultation the task book for the granting of a new spectrum licence in the 410-415/420-425 MHz band for providing private mobile communications services based on broadband digital land mobile PMR/PAMR systems. The licensee will provide mobile services to private users such as security and ambulance, public utilities, transportation services and industry. The current license holders in the 410-415/420-425 MHz band operating narrowband analogue terrestrial mobile services will be allowed to convert their analogue licences into digital ones upon request. The current licence holders operating fixed line services in this band will preserve their rights until the licences expire.

In Slovakia, TUSR is preparing a call for tender to assign FBWA licences in the 26 GHz and 28 GHz. The details of the call for tender will be published after the public consultation that was held in December 2006.

5.3.2.2 Regulatory for the VoIP services

According to the “ITU World Telecommunication Regulatory Database”, in 2006 only in Belarus, Russia and Ukraine individual users was not allowed to make VoIP phone calls, while in Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Greece, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Serbia, Slovakia and Slovenia, they were allowed.

Nevertheless, the only countries that had policies or regulations in place dealing with VoIP in 2006, were Greece, Moldova, Montenegro and Slovenia.

In Bosnia and Herzegovina, Estonia, Lithuania and Romania instead, the VoIP was subjected to general Telecommunication/ICT laws and regulations.

5.3.3 PLC Networks and Network Operators

The main power utilities in Eastern Europe are listed in the chart below.

Country	Main power utility	Country	Main power utility
Albania	KESH	**Macedonia**	ESM
Bosnia and Herzegovina	Elektroprivreda BiH	**Moldova**	ANRE
Bulgaria	NEK	**Poland**	BOT
Croatia	HEP	**Romania**	Electrica
Cyprus	EAC	**Russia**	Lenenergo
Czech Republic	CEZ	**Serbia**	EPS
Estonia	Eesti energia	**Slovakia**	ENELE
Greece	PPC	**Slovenia**	HSE
Hungary	MVM	**Turkey**	EUAS
Latvia	Latvenergo	**Ukraine**	NERC
Lithuania	Lietuvos elektrine		

Table 5-16 Main power utilities in Eastern Europe

As it regards the main PLC network utilities, they can be seen in the paragraph 5.3.5.2 (PLC cases in Eastern Europe).

5.3.4 Technical Network Configuration and Equipment Supplier

In Eastern Europe there are few trial-sites where the PLC technology is experimented, but the study and the realization of this trial-field is well distributed among a lot of companies manufacturing PLC equipments.

The main vendors that currently operate in Eastern Europe are: Ascom, Ilevo, Mitsubishi Electric, BIT Telecom, Electro-Com, Telkonet, Main.net and Corinex.

5.3.4.1 Ascom

[A40] Ascom is as an international solution supplier for secure and high-availability voice and data transmission. The Swiss Group is structured in the four business segments Network Integration, Security Solutions, Wireless Solutions and Transport Revenue, each built on a highly specialised technology base. The company concentrates on profitable international niche markets with organic and acquisition-supported growth potential.

In Eastern Europe, Ascom Powerline Communications realized, for the provider 23Vnet, a trial site in Budapest for 23Vnet) and in Zhelesnogorsk (Russia) for the electric company Energomegasbit O.O.O.

5.3.4.2 Ilevo

[E09] Ilevo was founded in 2000 as a spin-off of Ericsson. Relying on a team of telecommunication experts who have already been working for ten years within Ericsson, Ilevo developed from 2000 to 2003, one of the most powerful offers for broadband PLC applications.

In 2003, Ilevo was acquired by Schneider Electric who brought the electrical expertise needed to succeed in deploying the technology, the financial strength and the permanence as well as the local presence everywhere around the world. The Ilevo products are now designed and sold by Schneider Electric Powerline Communications, a fully owned subsidiary of Schneider Electric.

Today, Schneider Electric Powerline Communications is a company based in Sweden and France with several sales offices throughout the world providing our customers with a local presence while benefiting from a corporate group of highly skilled experts.

In Eastern Europe, Ilevo supplied a trial site in Bárdudvarnok (Hungary), for the Xyscom ISP.

5.3.4.3 Mitsubishi Electric

Mitsubishi Electric Corporation is a division of the Japanese colossus Mitsubishi, based in Tokyo. The firm, established on 1921, manufactures electric and architectural equipment, as well as a major worldwide producer of photovoltaic panels.

Mitsubishi Electric launched the first compact PLC on the European market 25 years ago. In the last years the Japanese company supplied the “Cézár” building and the “Mediterrán” residential park, in Budapest (Hungary), with its technology, providing a 70 Mbps connection to 550 flats of the residence.

5.3.4.4 BIT Telecom

Bit Telecom is a company with private capital whose mission is to activate the main telecommunication services on the Rumanian territory.

Together with Radiocom and Electrica, BIT Telecom supplied the necessary knowledge and equipment to realized the first Romanian PLC pilot-trial in the village of Band, in Mures County, where 10 PCs of the local school were connected through the PLC technology.

5.3.4.5 Electro-com

[E06] Electro-Com (PLT Electro-Com, Ltd or Company) is an independent licensed Russian telecommunications operator that provides Broadband access and alternative telephone services to consumers and small businesses in Russia, through Power Line Communications "last mile solutions." It operates under the "Spark" brand.

Electro-Com is organized in Cyprus, and is an independent licensed Russian telecommunications operator that offers SOHO and Residential subscriber telephony, Internet access, and IP-TV (triple play) services. A holding company, ZAO Electro-Com is located in Moscow, and has operating subsidiaries which are either 100% owned, or majority owned and managed by the holding company.

Through PLC technology and Fiber-to-the-Building-Network, the Company provides broadband services in 5 separate Russian Markets including Moscow, Rostov, Ryazan, Kaluga and Nizhny Novgorod. It has already connected over 150,000 apartments in the markets in which it operates, and signed up over 20,000 subscribers. Electro-Com is projecting a subscriber base in excess of 100,000 customers by the end of 2007, and over 1,000,000 apartments passed or ready for commercial services.

Electro-Com uses Powerline technology from Spanish chip provider (DS2).

Its Plug-and-play provisioning allows "renters" or temporary residents to obtain a service without obtaining permission of the owners-of-record for use of ADSL, or "drilling" through walls to lead wire pairs for home Ethernet. Actual measured performance for existing subscribers averages 40+ Mbps for both uploads and downloads, and is sufficient to carry television, music, interactive games, as well as normal voice and computer data.

The Company has developed a set of "Intellectual Property" consisting of "signal coupling" technology, as well as techniques and approaches to injection of signals in buildings, and maintaining very high throughput throughout the building. It has filed for patents for this technology and process. Having unique expertise in commercial use and deployment of PLC access technology the Company is offering its propriatory PLC-solutions through the system integration services and franchise. It targets service providers, system integrators, application developers and telecom equipment manufacturers worldwide.

The Company is funded by Barings Vostok Capital Partners, Russian Technologies (Alpha Group), and Intel Capital, as well as private financial groups.

Russian Technologies, backed by the Alfa Group Consortium, has been investing in young, innovative companies since 2003, assisting them to successfully develop Russian perspective technological projects.

5.3.4.6 Telkonet

[E07] Telkonet specialises in advanced integrated solutions for broadband data networking and energy management, including its highly successful in-building PLC technology.

Headquartered in Germantown, Maryland, USA, Telkonet has over 140 employees and serves thousands of customers worldwide.

The company's unique broadband networking solutions currently support more than a million network users per month, with its energy management systems optimising energy consumption in over 60,000 rooms. Telkonet's technology innovation is underpinned by the highest level of end-to-end quality of service, with comprehensive technical customer support. Its systems deliver wide-ranging functionality, from wired and wireless high-speed Internet access to energy management, IP surveillance and local area networking. Telkonet's platforms are widely deployed on the global stage: in single buildings and ships, in multi-building complexes, hospitality venues and multi-dwelling units, and at government, education and defence locations.

Telkonet's innovations include the revolutionary Telkonet iWire System™, which converts a site's existing internal electrical infrastructure into an IP network backbone, quickly, cost-effectively and without disruption.

For this reason, Telkonet has been select to furnish with its technology the Saray Regency Hotel in Turkey.

5.3.4.7 Main.net

[E11] MainNet Communications is a global provider of turn-key solutions and services for the broadband powerline communications market. Founded in 1999, MainNet offers flexible and customizable end-to-end broadband access solutions controlled by a feature-rich, Web-based network management system. Powered by the company's exceptionally dynamic smart repeaters, a MainNet-based broadband communication network is able to deliver Voice, Data and Video services over long distances.

In Poland, MainNet worked to an important trial site in the city of Krakow, where Pattern and Stoen providers wanted to offer some PLC-based services.

5.3.4.8 Corinex

[A42] Founded in 1989, privately held by a group of investors, Corinex Communications Corp. is the leading manufacturer of networking products which enable the transmission of all forms of digital data over a premise's already-existing cable infrastructure (electrical and coaxial cables) and via wireless connections.

Corinex has developed new comprehensive PLC access solution offering significantly lower cost of product, installation and maintenance.

In Eastern Europe, the Canadian firm worked in a trial site in Chomutov (Czech Republic), where The Hotel Royal was equipped with the PLC technology.

5.3.4.9 Others equipment suppliers

[E10] Ariane Controls is a Powerline Communication Technology developer offering highly differentiated networking solutions. Ariane Controls is a privately-held Canadian company developing PLC solutions for public utilities and building automation.

The commercial focus is on licensing its IP to chip vendors for them to incorporate in their product line, and to provide components suppliers and integrators with a more reliable and less expensive solution.

On 21 February 2006, Ariane Controls intensifies its European operations announcing a non-exclusive distribution agreement with VITA-ELKO, an Arrow Electronics partner based in Belgrade. “This partnership widens our opportunities in Energy Efficiency” noted Francis Raveneau, Ariane’s Business Development Manager and responsible for relations with VITA-ELKO. “We will work together to make sure that every opportunity in Eastern Europe is answered by Ariane’s technology”. “VITA-ELKO sees a tremendous potential in Energy Efficiency for the Eastern European market” noted Nenad Damjanovic, manager for VITA-ELKO. “Having already some client demands to replace their actual solution by the Ariane Controls technology, we decided to officialise our relationship and announce it on our local market to gain market share”.

VITA-ELKO is Belgrade-based electronics distributor active since 1997 in the fields of semiconductors, passive and electromechanical components.

5.3.5 Services offered and PLC-based Network Applications

The extension of the telecommunication grid, in Eastern Europe is enough spread to offer the most important services and something more. Nevertheless, it is not well used: the services offered to the customers are not so various and numerous. They focused above all on IP-TV and traditional internet (ADSL) but with a low bit rate.

5.3.5.1 Overview of the offered services

5.3.5.1.1 Internet service providers and Media broadcasters operators

[E18] Although broadband has been available for sometime in Eastern Europe, the advent of full scale fixed-line competition has boosted subscriber levels as incumbents in liberalised markets execute survival strategies centered on offering broadband and convergence services. The results are now being witnessed as convergence services are rolled-out. The need for more broadband speed has driven deployment of new high-speed broadband networks centered on ADSL2+ and FTTH while wireless has been utilised to rapidly deploy alternative networks and extend connectivity into remote areas. The number of ADSL2+ deployments is expected to increase during 2007 as triple play services grow in popularity. Public and private sector initiatives, an accommodating regulatory environment coupled with broadband proliferation has led to the emergence of the Internet economy, a nascent trend that will become increasingly visible as the prerequisite factors fall into place.

The developing broadband market is becoming increasingly sophisticated, with ADSL2+ services launched in Czech Republic, Hungary and Slovenia. IPTV services have been launched in the Czech Republic, Hungary and Poland, giving telecoms operators their much anticipated triple play services. Polish incumbent's triple play offering is based on the Livebox device from France Telecom. The satellite-based digital pay TV market is becoming increasingly crowded as a Romanian digital pay TV operator has commenced offering services in Slovakia, Hungary and the Czech Republic, recording strong growth in subscriber levels. A new satellite platform was launched in Poland, shaking up the previous duopoly, with satellite-based HDTV services. WiMAX services are growing in visibility as services are rolled out. However the delay in launching services in some countries will be to the detriment of wireless operators as incumbents continue their charge into the broadband market. Baltic Much anticipated broadband TV (IPTV) offerings are now available from the incumbent operators in each country, and brings the incumbent operators into direct competition with the cable-based operators in the consumer telecoms market. The resulting competition between the two parties is expected to heat up in 2007 and beyond, which will benefit consumers with increased variety and lower prices. Increasingly affordable ADSL offerings have been launched in conjunction with broadband TV offerings, stimulating broadband market growth. Speedier ADSL2+, required for a quality broadband TV experience, was launched by the incumbents in Estonia and Latvia, with Lithuania's incumbent deploying ADSL2+ infrastructure. The need for broadband speed has also spurred Fibre-to-the-Home (FTTH) network deployment in all three countries, most predominantly in new housing projects and apartments. Wireless broadband has become increasingly prominent.

Estonia has deployed WiMAX networks to extend broadband connectivity to rural areas while CDMA 1x EVDO based offerings are widely available in Latvia. WiFi in widely available in each country, with Lithuania's incumbent in particular making an effort to expand its WiFi network to approximately 1,000 hot spots by 2007. It is expected that wireless broadband will become increasingly prominent in 2007 and beyond due to greater availability of portable and mobile wireless broadband services, as well as the growing popularity of laptop computers, with approximately 65,000 laptop computers expected to be sold in Estonia in 2006 alone, up from 44,000 in 2005. Estonia has had the most success in fostering an Internet economy, developed in recognition of the ability of Information Communications Technologies to improve social wellbeing. E-commerce and e-government services are widely available, allowing the country's citizens to access services and carry out commercial and government-related activities online. Growing familiarity of such services, coupled with increasing broadband access will encourage usage among new users, generating efficiencies for both the providers and consumers of such services.

The untapped financial potential of underdeveloped broadband markets offers a new revenue source for incumbents suffering from competition in low-growth potential fixed-line voice markets. The big question hangs over the impact wireless will have on markets and in particular, technologies such as WiMAX.

WiMAX networks have been deployed in Serbia and in Croatia by the incumbent and an alternative operator, which has deployed a WiBRO network. A mesh WiFi network that will provide nationwide broadband connectivity is under construction in Macedonia, with all of the country's schools already connected. NGN/VoIP deployments are underway in Croatia by both the incumbent and alternative operators, in Greece by an alternative operator, in Macedonia by the incumbent operator, in Romania by the incumbent operator and in

Bulgaria by the incumbent operator. The desire to offer broadband and convergence service is driving NGN/VoIP deployments, with more deployments likely as the strategy of focusing on broadband and convergence becomes more common. Triple play services are offered by the cable operators, with Croatia's fixed-line incumbent announcing plans to offer services. An alternative operator has launched a competing triple play offer to that of the incumbent in Cyprus, based on its ADSL2+ network. ADSL2+ networks have also provided the base for triple play services by a Greek alternative operator. Romania has seen four digital satellite pay TV operators enter the market, with the largest and most successful player expanding services into Hungary, Slovakia and the Czech Republic, with plans to enter Serbia and Croatia.

As it regards the CIS areas, the Syvazinvest companies and alternative operators in Russia and Ukraine are generating increased revenue through mobile and Internet services, with plans to further grow revenue through broadband and IPTV. Plans to offer the aforementioned convergence and broadband-based services has driven the need to upgrade infrastructure, with numerous network upgrades and NGN deployments underway. Russian WiMAX deployment activity is continuing, with new deployments including mobile WiMAX underway. Operators involved in WiMAX developments include Start Telecom, Enforta, Internafta, MetroMAX, Infoseti, Synterra, Golden Telecom, Peterstar and Sibirtelecom. Services were launched in Ukraine in late 2005 by alternative operator UHT, with plans to expand coverage nationally and offer mobile WiMAX service, while services in Belarus are offered by the fixed-line incumbent. Broadband services in Russia are becoming increasingly popular and available due to increased infrastructure investment, with a large portion of the residential market continuing to be served by large informal LANs in Russia, with a similar situation in Ukraine. Deployment of faster broadband services such as ADSL2+ and FTTH is underway in Russia. Cable broadband services are experiencing a surge in popularity in Belarus and Moldova, although the phenomenal growth rates recorded have been based on a small initial user base. The growing popularity of broadband in Belarus is reflected in the country's growing internet user penetration, which rose by 36% during 2005. WiFi continues to be popular despite heavy WiMAX activity: Golden Telecom has deployed 3,000 access nodes out a total of 5,000 planned for its mesh WiFi network in

Moscow. Competing IPTV services to that of Comstar-UTS are available in Russia, with other deployments planned both in Russia and Ukraine.

5.3.5.1.2 VoIP and IP-TV service providers

[E13] IPTV is a truly global phenomenon, but the most recent DITTBERNER report reveals that Western Europe dominates the market with 68% of global IPTV subscribers, followed by Asia with 28%. North America, Eastern Europe, the Middle East and North Africa collectively comprise just 8% of the current subscriber quota.

DITTBERNER forecasts that Western Europe will continue to increase its market share due to a combination of factors, including aggressive geographical competition and the spread of pan-European carriers such as France Telecom, Deutsche Telekom and Telefonica. Eastern Europe, by contrast, is said to be struggling to switch its fixed network line to digital.

Among the Eastern European country, Russia (that it can be considered European only partly), is the nation with the greatest presence of IP-TV services, placing at the 8th position of the DITTBERNER's Top 10 Countries report.

<u>Russia</u>

[E14] On November 14th, 2007, Russia's Comstar UTS has acquired an 87.5% stake in the alternative telco Regional Technical Centre (RTC) for $21 million (€14.4 million) in cash. RTC is based in the Khanty-Mansi Autonomous Area, where Sistema-backed Comstar UTS already has a presence through Tyumenneftegassvyaz, the region's second largest alternative carrier. The acquisition will result in Comstar UTS's market share in Khanty-Mansi, which has a telco market estimated to be worth $255 million this year, rising to 33%.

In full Eastern Europe instead, Poland is the country with the greatest development of the IP-TV services, and partly of VoIP too.

<u>Poland</u>

Multimedia Polska is one of the leading (perhaps the first) Polish providers of triple play, combining IP-TV, broadband internet and fixed-line telephony in a single package.

[E15] On 13 November 2006 the Company's shares were first listed on the Warsaw Stock Exchange. The offering of their shares was the largest private offering in the history of the WSE and the largest offering in 2006.

The company operates across Poland in over 1,600 locations. As of 30 September 2007, Multimedia provided its services to a total of 626,000 customers of which some 193,000 customers used at least two Multimedia services (among TV, voice and internet), including over 39,000 triple play subscribers (combining all three services). Multimedia is among the most innovative Polish companies. It was the first Polish operator to launch digital television services for its telephony subscribers (IPTV) in the spring of 2006. It was also among the first operators to offer triple play, digital telephone services (VoIP) for cable television subscribers and broadband internet. The Company was the first operator in Poland to introduce High Definition Television (HDTV) in May 2007 and Video on Demand (VoD) in September 2007.

The number of broadband internet users in Poland has demonstrated strong growth over the past years. According to the Central Statistical Office (GUS, data published June 2006), broadband penetration in Poland grew by approximately 100% in 2005 compared to 2004. Yet the proportion of internet users to the total population is still among the lowest in Europe. The broadband penetration rate is expected to have reached 22% in 2006 and to reach even higher levels in 2007, benefiting from strong growth in the use of personal computers.

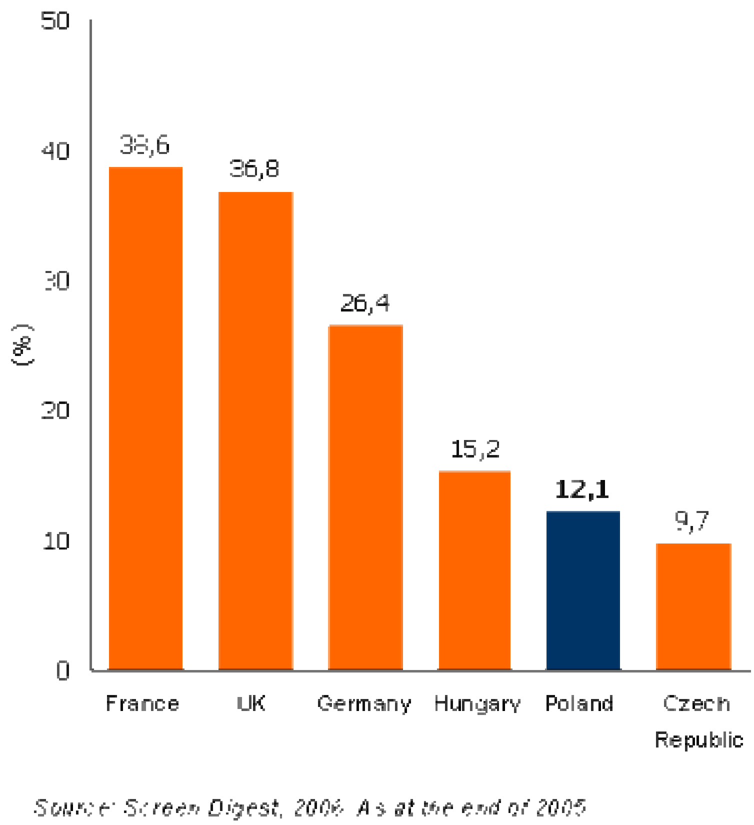


Figure 5-13 Broadband subscribers as % of total households

Multimedia is one of the largest cable internet providers in Poland. They also offer to some of their subscribers internet access by means of Wi-Fi technology.

As of 30 September 2007, they had some 190,000 broadband internet subscribers, including 168,000 cable subscribers and some 22,000 xDSL subscribers.

Multimedia also sells bundled services combining at least two of the three services: cable television, internet, and fixed-line telephony. The number of triple play subscribers has been growing rapidly: at the end of September 2007, triple play was subscribed by 39,000 clients. Some 193,000 subscribers took up at least two services.

The company expects the number of double and triple play subscribers to continue to grow at a fast pace.

As it regards the television market, according to Informa, the Polish cable TV market is one of the fastest growing markets in Central and Eastern Europe. Poland was the third largest cable television market in the European Union at the end of 2005 in terms of the number of subscribers.

The Polish cable television market is exceptionally fragmented with over 630 operators. However, the top four cable television operators in Poland (including Multimedia Polska) collectively account for approximately 47% of all cable television households.

According to Informa, Poland's 5.1 million cable television households represented 40% of all television households in 2004. The Polish cable television market is expected to grow to 5.9 million households, or 46% of all television households in Poland, by 2011. The key growth driver for this market will be the cable product mix, which will be expanded by adding pay-per-view services, broadband internet access and telephony services.

Multimedia were the first company in Poland to offer IPTV, which was launched in April 2006. The service is now available in Mielec, Kutno, Brzesko, Dębica, and a number of smaller towns in the south of Poland. It was also the first cable operator in Poland to roll out video on demand (virtual video rental) in September 2007.

Currently Multimedia is planning to offer its customers a wide range of interactive services, such as:

- Time-Shift TV: a service which allows for viewing television programmes broadcast in the previous week.
- T-Commerce: a service which enables customers to purchase products and services via television in a manner similar to internet shopping.
- Games: it includes network games.
- Mail and messenger

As of 30 September 2007, the company delivered cable television, DTV and IPTV services to 561,000 subscribers.

As it regards the telephony, according to the EU Report, there were 69 operators offering fixed-line telephony services in Poland as of September 1, 2005. The fixed-line telephony decline that is clearly visible in most of the other member states of the European Union has not yet affected Poland to the same extent. In fact, if one looks at the whole 2000 to 2005 period and not just 2005, this sector in Poland grew considerably as the number of main telephone lines in absolute terms and in per capita terms increased by 3.3% and 3.4%, respectively. The Polish fixed-line market still has potential for growth.

As shown in the EITO Annex, in 2005, an average Polish consumer spent € 261 on telephony services while in Spain (similar to Poland in terms of population), the average spending reached € 721 per capita. The spending on telephony services in Poland is also considerably lower than in the Czech Republic or Hungary.

Multimedia offers standard telephony services and a number of additional services provided over conventional PSTN networks as well as cable networks using VoIP (digital) or HDT (analogue) technology.

At the end of September 2007, Multimedia's clients used some 159,000 telephone lines, including 104,000 PSTN lines and 55,000 cable network connections (mostly VoIP).

Besides Multimedia, there are others multimedia service providers in Poland, such as DTV Service, TPSA and Vectra.

[E14] The Polish incumbent telco TPSA would start to offer internet access speeds of up to 50Mbps in parts of Warsaw from later November 2007, according to a local report. Although the France Telecom-backed company launched an IPTV service almost 18 months ago, only around 30% of its existing infrastructure is capable of delivering broadband internet and video.

In the same day (14^{th} November 2007), the Polish MSO Vectra has announced that it plans to have 100,000 digital TV subscribers by the end of the year. Speaking to local sources, Vectra also said that it expects to introduce HDTV, VoD and PVR in 2008. Vectra launched its digital TV service in November 2006, and as of the end of this year it was received in 75,000 homes. It is currently available in 14 cities, and the growth will partly be achieved by the service's expansion to Bialystok in the north east of the country. Vectra vies for second place in the Polish cable league table with Multimedia Polska and ended with a total of 645,000 subscribers for its triple play offer.

Another company entering in the IPTV market is Nokia.

[E16] Nokia Siemens Network in fact, has signed a contract with Dialog telecom to deliver and integrate an interactive TV and video-on-demand platform. The test installation was rolled out in June and the commercial roll out is expected for end of 2007.

Nokia Siemens Networks will also supply the set-top boxes for the consumer homes to allow the new multimedia services to be used.

The IPTV solution extends Dialog's existing portfolio. Subscribers will thus be able to create their own individual service package combining dedicated fixed-line telephony, internet access and innovative fixed-line digital television (IPTV). Available features of the IPTV solution will include TV Pause (pause and start of the TV program being watched) or Digital VCR (which allows material to be recorded on-demand from a selected TV channel). In addition, the Video Rental feature will allow subscribers to rent movies from a library of several thousand movies.

"We are pleased that we will be deploying the IPTV Nokia Siemens Networks solution in Poland, too. This is an important step to introduce new competitive services for the Polish market", says Thomas Werner, Head of the Business Line Applications, Nokia Siemens Networks.

Croatia

The most important broadband provider in Croatia is T-Com. The ISP offers a lot of "traditional" services and also some new and innovative service. As it regards IP-TV, T-Com offers a wide television selection of over 65 channels (domestic and foreign stations) by the mean of its MAXtv package.

[E17] With MAXtv, T-Com's customers can order movies from their sofa, as there are over 1000 motion pictures available in the MAXtv VideoArchive. Using a simple interactive guide, they surf through content that provides a complete overview of what's on offer, with descriptions of shows, movies, and searches by keyword, genre, alphabetical order, etc.

Czech Republic

The main IP-TV providers of the Czech Republic is VOLNÃ TV Service.

[E16] Telekom Austria Czech Republic is the leading telecommunications operator in the Czech Republic. Under the brand VOLNÃ it offers a full portfolio of telecommunications services including, internet connections, voice services, fixed line and wireless data services, network services and a full range of value added services, such as: web hosting, server housing (with housing centers in Prague and Brno), domain name registration, digital TV based on IPTV technology and security services.

VOLNÃ is one of the first Czech telecommunications operators with its own high-speed internet network based on the state-of-the-art ADSL2+ technology covering 40% of all fixed phone lines in Czech Republic. VOLNÃ is able to offer IPTV service together with data and voice services in high quality at low prices. The TV service is a response to the growing demand for entertainment.

VOLNÃ TV is currently available in Prague and Brno, exclusively on VOLNÃ's own network.

Greece

The most important IP-TV service provider of Greece is ON Telecoms.

[E16] ON Telecoms launched the first IPTV services in Athens in late January. The company operates a metropolitan fiber network in the Athens area, on which advanced triple play services are delivered. ON Telecoms completed the initial phase of a fully owned metropolitan fibre network in Attica of more than 170km. Its services are available today for 40% of households and businesses and will reach 80% by the end of 2007.

Within the triple play offering, ON Telecoms' aim is to introduce next generation TV and video services, offering its customers an array of entertainment packages: ON Telecoms will deliver Catch-up TV, NPVR, VoD and other On Demand services.

Hungary

Also Hungary has an IP-TV provider: TVnet and it offers services similar to others Eastern European providers.

<u>Lithuania</u>

Concurrent Secures is the main (and probably the only) video provider present in Lithuania.

[E16] Concurrent announced the commercial deployment of video-on-demand in Lithuania in 2007. Lithuanian telecommunications provider UAB Alpha komunikacijos has chosen Concurrent's MediaHawk On-Demand Platform to launch the new broadband system that is projected to reach up to 40,000 IPTV subscribers in a decentralized architecture covering most of the major cities, including Vilnius, the capital city. The sale is the second one in the Baltics to be secured through Concurrent partner Scansatec, one of the leading broadband and IP technology providers in Finland and the Baltics. Concurrent is now the sole on-demand vendor in the entire Baltic region.

In Lithuania alone, cable television operators pass approximately 620,000 households, which represent a huge growth opportunity for on-demand services.

"Concurrent was chosen because of their flexible and scalable architecture", stated Tero Jousi, owner and general manager of Scansatec. "Their superior technology has helped us tremendously in securing these Baltic markets, and we are confident that our partnership will garner additional markets in Eastern Europe".

Marius Dabrisius, CEO of Alpha komunikacijos, views the MediaHawk on-demand solution as field-proven and the only reliable on-demand solution for their system. "We trusted Scansatec with our head end gear and middleware", he said. "Their recommendation of Concurrent for the on-demand solution was supported by the fact that Concurrent has shipped more IP streams to Europe than any other provider".

To date, Concurrent has deployed over 1.1 million video streams in 26 countries.

<u>Romania</u>

The main IP-TV operator in Romania are Atlas Telecom Romania and Ines.

[E16] This year, ECI Telecom announced that it signed a contract with Atlas Telecom Romania to expand their broadband network. The three-year contract will provide Atlas Telecom Romania with the ability to cost-effectively offer triple play and IPTV services.

ECI will provide its IP DSLAM platform to support Atlas Telecom's applications to both residential and business subscribers. ECI's ADSL2+ based equipment will be co-located in the central offices of the incumbent operator in Romania, to support residential services. ECI's outside plant solution will be installed within Atlas Telecom's own street cabinets, using VDSL2 line cards, to support business subscribers.

[E14] Romanian IPTV operation Ines instead, plans to invest € 500,000 on its network in 2008, according to a local report. Part of the money will be used to prepare for the introduction of such additional services as HDTV. Ines claims to be the first IPTV operation in Romania and provides its service in upmarket parts of the capital, Bucharest.

<u>Slovakia</u>

UPC Broadband Slovakia is the most relevant multimedia provider of Slovakia.

[E16] On November 14th, 2007, the company has announced that it will not raise the prices for any of its services from the beginning of 2008. These now include a 70-channel digital cable TV offer named UPC Digital, which made its debut earlier this year, as well as analogue cable TV, broadband internet access and telephony.

<u>Slovenia</u>

[E16] T-2 is the number one alternative IPTV operator in Slovenia that offers a wide selection of movies, series and other video content, available for on-demand viewing.

In this year, Verimatrix announced the successful deployment of Verimatrix's Video Content Authority System for T-2's IPTV deployment.

While traditional conditional access systems are architected around one-way communications, Verimatrix has designed its solutions from the ground up using the power and integrity of modern two-way IP infrastructure.

"We are very pleased to have worked with Smart Com to provide an exceptional content security solution tailored for the T-2 IPTV service", commented Robert Payne, VP of sales, EMEA for Verimatrix. "This deployment demonstrates the extent to which the IPTV technology can enable new businesses and extend consumer choice".

<u>Ukraine</u>

[E16] During 2007 digital TV in Ukraine has taken a major step forward and companies already established in the market are starting to reap the benefits of their investments in marketing. In Ukraine alone there are 17 million TV households.

DTH's three operators have announced their intention to launch a DTH service to the Ukraine population of over 43 million people. Poverkhnost is already transmitting DVB-S services including 2 HD channels. DataGroup has launch DTH in HD standard. Vision TV is preparing for a launch later this year. If the Ukraine DTH market is anywhere near as successful as DTH launches in Poland and Romania, it can be predicted to see 850,000 new subscribers in the next 3 years and 2.5 million in 5 years.

Digital Cable has now commenced in 5 Ukraine cities with different operators including Kiev, Donetsk, Kharkiv, Krivoy Rog, Odessa. With a high CATV penetration in Ukraine, digital TV is expected to grow significantly.

Four of the largest IPTV telco in Ukraine have started IPTV trials this year. They are: Ukrtelecom, Golden Telecom, Comstar and Telesystems.

5.3.5.1.3 e-Services

As it regards the diffusion of the e-services, the Cypriot situation is representative.

[E34] Only 7% of Cypriot enterprises that use the internet actually accepted orders via the internet in 2006, although this was higher than the 5.1% reported in 2005 according to the annual "Information and Communication Technologies Usage and E-Commerce in Enterprises" survey.

At the same time, a parallel household survey found that only 6.7% of individuals ordered products over the internet, although this was higher than the 5.1% recorded in 2005. These individuals ordered mainly books, magazines, newspapers and e-Learning material.

Regarding e-Government, businesses are interacting more with the government online. Business using the Internet for interaction with public authorities (mainly obtaining information) increased from 39.5% in 2005 to 44.3% in 2006.

5.3.5.1.4 The market of the AMR

In Eastern Europe there are a lot of companies offering AMR products. One of the most important is the Unikom-Ug, headquartered in Odessa (Ukraine).

[E12] The Unikom-Ug is a subsidiary of ANB International of USA. They handle most of ANB's metering business. Unikom-Ug is one of the largest and oldest companies in Ukraine (Ukraine was a scientific center of the USSR, with much of research in aeronautics, military and other applications done there).

Unikom-Ug is mostly engaged in defense industry. They also completed a number of projects in industrial automation, notably in the power sector.

The products of Unikom-Ug are very competitively priced. Large development expenditures led to a highly integrated design with relatively low manufacturing cost.

The company offers the full range of metering solutions, from basic electronic meters, simply a replacement for the mechanical ones (their price is even lower than that of mechanical) to the most complexes solutions.

The electronic meters have many advantage: first, they are highly reliable, with no accuracy drift during the lifetime. They are well protected against tampering, like energy flow reversal, phase-neutral swap, neutral disconnection or opening of the meter. Next, they offer some additional features, like maximum demand measuring and reading from optical port. Also, there are many upgrade options, notably to multi-tariff, whether time-of-use or slab tariff, and to power line carrier (PLC) automated meter reading (AMR) or other networks.

The PLC AMR warrants more description. According to Unikom-Ug, this is the most effective way to cut utilities' losses. AMR boards are installed in mechanical or electronic meters and read the rotating disk or pulse indicator, accordingly. Load profile data is then continuously sent through the power cable to the receiver, which is a small device installed at transformer or substation. From there the data is transferred to the central office through telephone line or GSM. Thus, the utility office can read any meter, simply sitting in his office. No more the customer has to pay by assessed reading and, of course, now he cannot bribe the inspector to change the reading. Most importantly, utility gets not only the month-end reading, but also continuous stream of load data.

Now it becomes impossible for customer to change meter readings. He also cannot claim absence from home, because continuous meter readings will show that he, indeed, was using electricity all the time but at strangely low rate. By analyzing the consumption patterns, our software generates the report on suspicious customers. Then the inspectors can check these users. Moreover, the system compares incoming and outgoing energy on each feeder, so that illegal connection can be easily terminated.

As an additional benefit, PLC AMR allows introducing multi-tariff system with mechanical meters.

Many meters can be connected to concentrator through PLC, and from there they can be linked to central office with phone or GSM modem.

Unikom-Ug sells PLC AMR modules for $3.95 (€ 2.70). These modules are extremely durable and reliable for automated reading of electric power meters, smart house and industrial automation.

The powerline modules use Unikom's proprietary algorithm which provides moderate speed (not suitable for broadband powerline communication) but extreme reliability of PLC AMR and very low price. The powerline modules operate as modem, thus drastically reducing development time of PLC AMR. Their PLC AMR modules tested at 2.5 km distance and work even in old, poorly connected power grids with high noise level.

Each PLC module is a self-contained transmitter/receiver: no special PLC modems are required. Furthermore they are compatible with all applicable standards.

5.3.5.1.5 Internet service providers

In Appendix A they are listed, for every Eastern European country, the principal provider of internet/broadband connection and the respective status.

In this section they will be only described the main ISPs, especially regarding the prices of their services.

<u>ON Telecoms</u>

[E19] The Company is fully owned by ON Network Holdings NV registered in the Netherlands. ON Network Holdings Shareholders include the company's top management and ARGO Capital Partners Fund LTD as financial sponsor.

On Telecoms has completed the initial phase of a fully owned metropolitan fibre network in Attica (Greece) of more than 170km. Thanks to this network, the largest in the region besides that of OTE, ON Telecoms services are available today to 80% of households and businesses. On Telecoms access network is based on fibre connecting the incumbent's central offices and customers requiring very high capacity. Through full unbundling, On Telecoms innovative access technology guarantees full control of the network and service quality.

The provider offers business and residential services. For the office business, ON Telecoms offers one telephone line with 700 minutes for calls (to local, long-distance and 15 international destinations) and a broadband access up to 16 Mbps in downstream (1 Mbps in upstream) at € 40.

The residential products are: Telephony & TV, Telephony & Internet, All in One and they are sold at € 27, € 32 and € 35 respectively.

As it regards the telephony, services includes free unlimited local and long distance calls. Internet connection is unlimited and with a speed up to 16 Mbps, while TV service includes Greek and international channels in digital quality.

<u>Spark-Com</u>

[E06] The Russian company offers its subscribers the ability to compete with each other in online games and to download or listen to music. It maintains a set of servers within each of its cities for subscriber use, obtaining licensed music and games, and providing these to subscribers as requested.

Broadband internet access includes:

- Unlimited volume and throughput: No volume based traffic charges are made, and subscribers obtain service at a performance level limited only by the in-building electrical infrastructure. Generally this is on the order of 40 Mbps to the subscriber adapter.

- Choice of IP address scheme: Subscribers can choose either a dynamic, local IP address or single, or multiple public IP addresses, obtaining either residential or commercial type of services. In either case both upstream and downstream throughput are approximately the same (vs. ADSL which is imbalanced).
- Ability to easily give access to multiple devices: A subscriber may connect multiple devices to internet through independent access links. For example, individual accounts may be set up for different IPTV services, or different PC devices, within the same apartment. Each may be configured as "unlimited" or have separate performance limitations.

Electro-Com has demonstrated prototype IPTV services delivered on its network. It has provisioned a minimum performance level to each of its subscribers so that it may provide such services as they are brought on line. The development organization has developed, and is in process of providing field trials to Electro-Com subscribers on its network, consisting of: Video-on-Demand, Shift TV Broadcasting, Web-TV, Surveillance, Real-Time Broadcasting.

Furthermore, the company is building first large-scale PLC broadband network in Russia.

T-Com

[E17] TcCom is Croatia’s leading telecommunications provider of both fixed telephony and internet services. Its broad spectrum of telecommunication services (voice telephony, data transmission, dial-up or wireless access to internet and local area networks) are enhanced with mobile phone services offered by T-Mobile, T-Croatian Telecom’s subsidiary.

Besides generating the largest share in Croatia’s internet traffic and introducing the state-of-the-art communication methods parallel to their appearance on international markets (wireless access via WiMAX), T-Com is also the leader in developing new internet content, so it was even the first among the DT Group to offer the highly demanding MAXtv (internet television).

T-Com offers 3 packages to its customers:

- Start 1 GB: up to 2 Mbps speed with 1 GB of internet traffic

- 5 GB: up to 2 Mbps speed with 5 GB of internet traffic
- Flat: up to 2 Mbps speed with unlimited internet traffic

<u>Alternet</u>

[E20] Alternet is a young and developing company providing high-quality service to its customers. The company was the first in the CIS and one of the first in the world to build a wireless network using the innovative WiMAX radio technology.

The Alternet network began working in November 2005. At first the coverage area included Kyiv and Kharkiv. During 2006, Alternet expanded its borders to satellite cities. At the end of 2007 the network will expand at all regional centers of Ukraine.

Alternet is a trademark that belongs to "Ukrainian High Technologies" Ltd. The company has a license of the National Communication Regulation Commission of Ukraine #5241 dated 01/11/06, allowing it to use the 3.4-3.6 GHz frequency range throughout Ukraine to expand the WiMAX network. The company's investors are Intel Capital and Russian Technologies venture funds. Intel Capital international fund is part of Intel corporation and one of the largest venture funds in the world. The fund invests finances into innovative and prospective technological companies throughout the world. Russian Technologies venture fund was founded in 2003 by "Alfa-Group" Consortium.

The traffic plan for residential customers is the following:

Access rate (Kbps)	Monthly payment	Installation cost	Included traffic
128	€ 13	€ 81	1000
256	€ 20	€ 87	1500
512	€ 33	€ 101	2500
1024	€ 54	€ 121	4000
2048	€ 94	€ 162	7000

Table 5-17 Traffic plan for WiMAX service in Ukraine (capped)

The tariff plan for the unlimited traffic is instead:

Access rate (Kbps)	Monthly payment	Installation cost	# of telephone lines
128/32	€ 27	€ 94	-
256/64	€ 40	€ 107	-
512/128	€ 67	€ 134	1
1024/256	€ 121	€ 188	2
2048/512	€ 201	€ 269	4

Table 5-18 Traffic plan for WiMAX service in Ukraine (uncapped)

5.3.5.2 PLC cases in Eastern Europe

Despite the existence of some good electric distribution grids, Eastern Europe has moved a little bit later into PLC than the western part of the continent. Nevertheless the most advanced nations from the telecommunications point of view have started some meaningful tests. In particular, at the moment the PLC technology has found employment in Romania, Hungary, Russia (the European side), Turkey, Poland and Czech Republic.

5.3.5.2.1 PLC cases in Hungary

[E03] To study the feasibility of a PLC system in Hungary, laboratory investigations in one-to-one scale network and site investigations on RBS LV feeder line have been made since the first years of the 2000’s.

Features of the one of the tested PLC system where: OFDM modulation, 768 carrier downstream (max), 512 carrier upstream (max), programmable carrier power profile, continuous channel SNR monitoring, adaptive bit rate adjustment, 4 frequency bands (2 - 4.5 MHz, 5.6 - 8.1 MHz, 10 - 12.5 MHz, 15 - 17.5 MHz). The equipment was based on DS2 technology. The LV network configuration of this site trial is shown in the figure below.

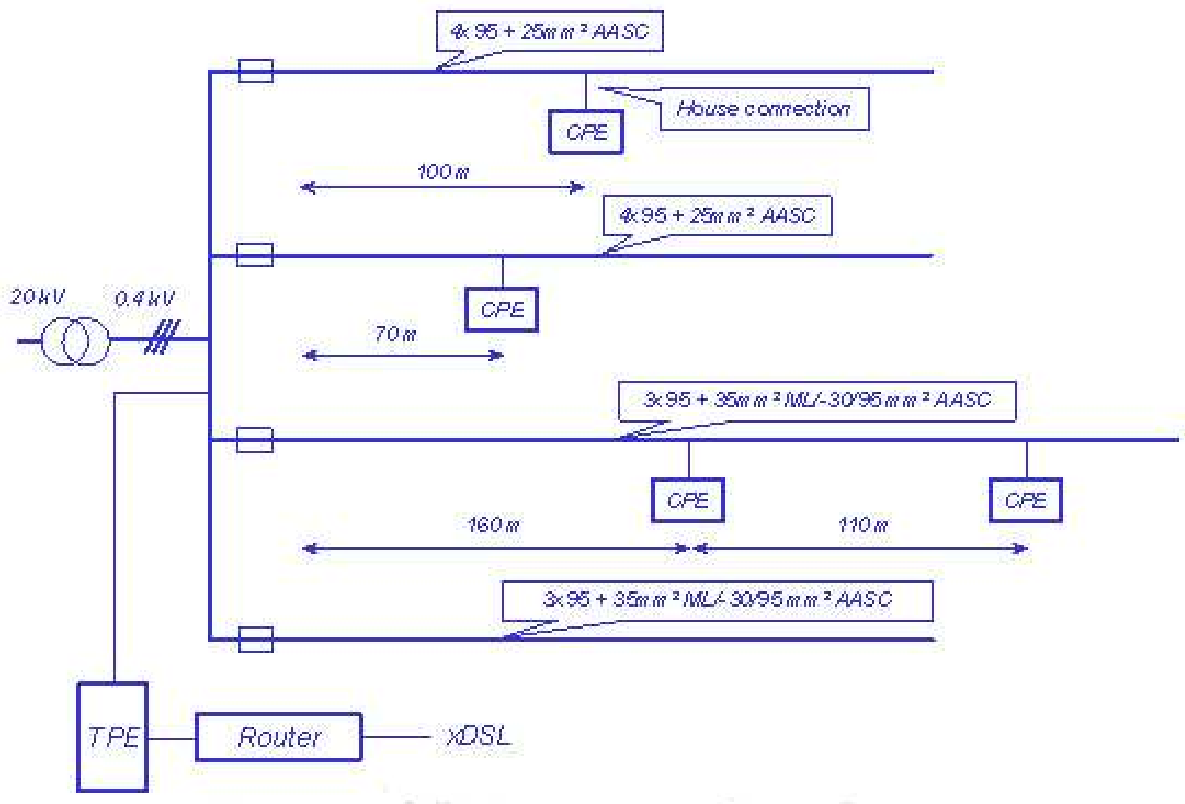


Figure 5-14 LV network configuration of the Hungarian trial site

The LV feeder line of the site trial is instead shown in the following figure.

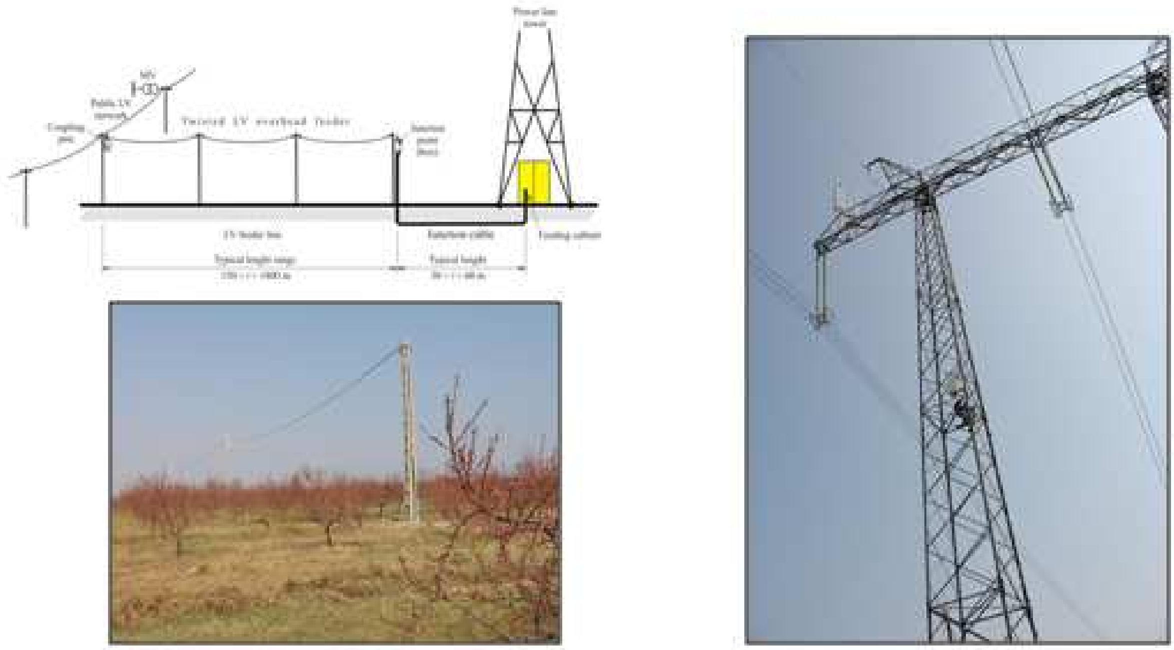


Figure 5-15 LV feeder line of the site trial in Hungary

The system used some PLC HE (head end) with capacitive and inductive coupling (one, two or three phase to neutral, phase to phase and any other combination) and other PLC modem with only capacitive coupling (only phase to neutral). Frequency used, varied between 13.8 to 16.3 MHz in upstream, and between 19 to 22.8 MHz in downstream. The injected signal level was of 30 dBm (at the maximum) and the data transfer rate reached the speed of 27 Mbps in downstream and 18 Mbps in upstream.

The first commercial application based on the PLC technology was launched in December 2003 in the Riverside apartment-house in Budapest by 23Vnet Ltd. After 4 months the service was counting 100 users from 450 apartment owners. The bandwidth is 4.5 Mbps.
The PLC equipment where supplied and installed (in less than 2 months) by Ascom.
[E04] The Hungarian company 23Vnet Ltd is owning and managing the network by themselves and the service is already in commercial operation. The first response from end-

users were very positive and therefore further installations will be worked out. To lower the initial investment, customer used one Indoor Master per stairway with 9 floors each. This was enough for connecting an average of 10-15 users. The backbone connection is realised by a wireless solution with an antenna on the roof of the buildings. The Indoor Master is located in the electricity room of each stairway. Up to 32 active users can be served with one Indoor Master and it is possible to further divide the stairway to cover additional Indoor Masters.

Ascom supported 23Vnet Ltd. also in the planification process as there are several types of installation concepts for multi-apartment buildings that can be adapted in a very flexible way to the customer requirements. It is foreseen that the same installation model could be applied to other multi-tenant buildings throughout Budapest, mainly in suburban areas. To enable broadband availability to such locations, customer is very optimistic to get government funding to further deployment of the PLC technology.

Figure 5-16 Riverside apartment-house in Budapest

[E03] In April 2004 Xyscom launched a regional integrated broadband telecommunication service integrating three technologies: traditional copper wire link, radio link and PLC technology (14 subscribers). The system was installed by Hungarocom Telecommunication Ltd. At Bárdudvarnok, using ILEVO hardware (DS2 chipsets).

Figure 5-17 Bárdudvarnok site trial area

System Consult Ltd. also started a PLC research in the Budapest University of Technology and Economics in 2002 with the collaboration of the Departments of Electric Power Systems and Telecommunication Engineering. Investigations was conducted using a one-to-one scale LV network. The in-home service in the office building of the System Ltd. was based on PLC equipment with EBA hardware.

Finally, Communication Unique (Communique) Kft., a service provider for internet telephone and cable TV, has launched a non-commercial trial and initiating a commercial trial by the end of 2006 on the network of ELMŰ and ÉMÁSZ Utilities. The hardware was supplied by Mitsubishi Electric (PLC LINK 2000 products).

The Communique commercial applications are:

- “Cézár” building: the transmission rate to the 9th floor reached 70 Mbps
- “Mediterrán” residential park: operates on the ELMŰ (Budapest Utility) network on contract bases and gives access to 550 flats. The target was the commerce service.

Figure 5-18 Mediterrán residential park

5.3.5.2.2 PLC cases in Romania

The Government of Romania started a campaign to develop broadband services in Romania.

[E01] The target of this campaign is to increase the penetration rate of using the internet among population from 28% to 33% until the end of 2007, meaning approximately 7 million of internet users.

The first two stages consisted in offering free-access internet areas. The third stage consists in providing hotspots in public areas, where the population can have free access to a flexible mobile internet service (wireless internet).

In addition, the Romanian Government is considering PLC technology like the best technology for providing communications services in the rural areas.

Altogether, the project involves 255 communities (9 in pilot-phase), 472 schools and 1,740,000 citizens (18% of total rural population).

In December 2005, the feasibility study for implementing the PLC technology has been finalized. During the period Feb-Aug 2006, the PLC pilot project functioned in the village Band, Mures County. An impact study followed the pilot project, which revealed the opportunity of implementing the PLC technology in certain conditions.

[E01] The authorities decided to invest in the development of the PLC pilot project at Band because it was one of the least connected villages to systems of communication.

The Minister of Communications and Information Technology decided starting the pilot project in July 2005, when it launched the auction for ascribing the implementation of this project. The project consisted in realizing a PLC network at which will be connected a number of 50 phone terminals and 10 PCs (using 50 modems and the connecting equipment of a working PLC system).

The minister for IT&C Nagy said the inauguration day was of great importance for the people of Band village: “I am sure this is the way to go for providing access to communication network in the rural areas”. “From now on, the world will be closer to the citizens of this village, and all the information they could access with difficulty before, is now available at just a click away. We managed, by means of this technology, to ensure the access to telephony services and internet for the people. I am convinced that PLC is a viable alternative for the rural areas”, declared minister Zsolt Nagy on the occasion of the inauguration ceremony, that took place at the school in Band.

The project had an experimental duration of 6 months. After this time, the impact on the community of the PLC system will be evaluated and a national strategy for implementing the solution countrywide will be drafted.

The costs for phone and 64 Kbps internet access stay at around 5 euros and 7 euros per household.

Companies BIT Telecom, Radiocom and Electrica worked to bring the PLC system to the village of Band.

5.3.5.2.3 PLC cases in Russia

In the USSR PLC was very common for broadcasting, because PLC listeners cannot receive foreign transmissions. Now, in Russian Federation, Electro-com has deployed widely PLC technology and is offering internet, telephone and television services in Moscow, Nizhny Novgorod and Krasnodar, with plans to extend coverages to main Russian cities.

Based on DefiDev equipments with DS2 chipset, the company provides currently 512 Kbit/s, 1 Mbit/s and up to 100 Mbit/s of different qualities of plug&play services for subscribers at the price, respectively, of 400 RUB (11 €), 500 RUB (13.8 €) and 750 RUB (20 €).

Currently the company has 35 thousands of subscribers and has an annual growth of 15-20%, according to the financial newspaper Kommersant on 21 September 2007.

[E06] Electro-com (PLT Electro-Com Ltd) is an independent licensed Russian telecommunications operator that provides broadband access and alternative telephone services to consumers and small business in Russia, through Power Line Communications. It operates under the “Spark” brand and currently is building first large-scale PLC broadband network in Russia.

Through PLC technology and Fiber-to-the-Building-Network, the Company provides broadband services in 5 separate Russian Markets including Moscow, Rostov, Ryazan, Kaluga and Nizhny Novgorod. It has already connected over 150,000 apartments in the markets in which it operates, and signed up over 20,000 subscribers. Electro-Com is projecting a subscriber base in excess of 100,000 customers by the end of 2007, and over 1,000,000 apartments passed or ready for commercial services.

The Electro-Com's network consists of a fiber optic "gigabit" metro Ethernet network, with a PLC final in-building segment. Latency is extremely low (less than 30 msec to Internet Exchange Point), allowing "Triple Play" services. Electro-Com has demonstrated prototype IPTV services delivered on its network. The existing average speed of 40 Mbps for both uploads and downloads is in fact sufficient to carry television, music, interactive games, as well as normal voice and computer data.

[A40] But already in 2002, the big company Ascom Powerline Communications and the Moscow energy supply company Energomegasbit O.O.O. signed a contract for the supply of Ascom PLC technology. In the following months, 20,000 Powerline connections were installed in the Russian town of Zhelesnogorsk (400 km to the south of Moscow) which has a population of some 100,000 inhabitants.

Energomegasbit O.O.O., which is active in the field of energy supply, cooperated closely with local telecommunications providers for the marketing. The product offering includes access to the broadband Internet as well as telephony via the electricity supply grid.

"Powerline Communications is an excellent opportunity to develop the Russian market for broadband internet and telephony, also outside the large cities", said Vladimir Molodetsky, Managing Director of Energomegasbit O.O.O. "Together with our partners we will work to rapidly take advantage in Russia of the potential of this innovative communications technology".

Stefan Riva, Head of Ascom Powerline Communications, is also convinced of the business potential of Powerline Communications in the Russian market: "Russia is a very attractive market. The coverage of an area with broadband access and telephony through the use of the existing electricity supply grid is a convincing alternative to the traditional technologies".

5.3.5.2.4 PLC cases in Turkey

[E07] On 27th September 2007, Telkonet Inc., the leading US technology solutions provider for broadband networking, end-to-end service support and energy management, reports that it has completed the first installation of its Telkonet iWire System™ in Turkey, with the system going live at the prestigious Saray Regency Hotel in the popular resort of Antalya. The Telkonet solution was supplied and installed by Telkonet's Turkish VAR, TunçNet, equipping the 5-star 196-room hotel with High-Speed Internet Access (HSIA) in just 6 hours. Based on Telkonet's innovative PLC technology, the installation used the hotel's existing electrical wiring to achieve a high performance broadband network with zero disruption to either guests or to the hotel's operation.

The Saray Regency's management was looking for a cost-effective, future-proof broadband platform that would provide an instant solution to its requirement to enhance guest services with HSIA. Dating from 1989, the hotel is built on five storeys with additional recreational and restaurant facilities. The Telkonet iWire System was selected after a thorough market evaluation, as Sales & Marketing Manager and Front Office Manager Noyan Kiliçturgay explains: "We conducted careful research, including discussions with other hotels about the best options for fast-to-install broadband solutions and an evaluation of the various options. We ruled WiFi out as not providing us with a suitably reliable and cost-effective system, whereas Telkonet's solution matched all our requirements for ease and speed of installation, as well as performance and cost. I made the recommendation and our General Manager Yaşar Sunal authorised the installation as the best option to fulfil guest expectations and consolidate our market position. The installation process was absolutely painless: to have HSIA up and running in just 6 hours is a remarkable achievement. We are delighted with the result".

The Saray Regency installation consists of a central Telkonet iWire System and a Telkonet eXtender™, with additional couplers located on each floor. The Telkonet iWire System operates by transforming a building's existing electrical wiring into an IP network backbone, enabling each electrical outlet to be used as a broadband access data port via Telkonet iBridge™ interface units, which are installed in every guest room. This enabled every room at the Saray Regency to be enabled immediately for Internet access as soon as the system was installed.

5.3.5.2.5 Others PLC cases

In Eastern Europe there are others PLC site trial, especially in Poland and Czech Republic.

In Poland there is a commercial PLC network in Krakow. The equipments are supplied by Main.net Israeli company, while services to the customers are offered by Pattern and Stoen providers.

In Czech Republic, PRE is the ISP that offers PLC services to its customers.

Nevertheless the diffusion of the PLC technology is limited, at the moment, to small centers, hotels, restaurants, schools and historical buildings, because of the particular architecture of the ancient Eastern European cities.

[E08] In many European buildings in fact, the rewiring of historic or old buildings with network cable is simply not feasible, with costs being prohibitive. In addition, due to the extensive use of stone and concrete as core building materials, wireless connections have also proven to have limitations. Powerline technology bypasses all of these obstacles.

Corinex has deployed their PLC-based product in many sites around Europe. In Czech Republic, an example is given by The Hotel Royal, an historic 300-room hotel in Chomutov.

According to Corinex, the adoption rates are expected continue to grow throughout all markets particularly, in the coming months as new products are released and new powerline networking standards are developed.

5.3.6 PLC Network and Equipment Statistics / Volumes

[E21] The telecoms markets that make up Eastern Europe are not homogenous as those in the west, reflecting the various stages of economic development in each country.

The Czech Republic, Lithuania and Cyprus had penetration levels in excess of 100% as at March 2005, with Estonia, Slovenia and Greece near 100%. Russia's massive mobile market is maturing although it is still showing strong signs of growth as the mobile operators concentrate on acquiring subscribers in the outer regions, where penetration in some regions is in the single digits.

Third generation mobile services have been launched in Slovenia and Hungary but the launch of services have been delayed in Poland and the Czech Republic numerous times by the operators. A number of countries also offer Enhanced Data Rates for GSM Evolution (EDGE). Commercial launch of 3G services that have occurred in the Balkans in 2005 and in 2006 include Croatia, Cyprus and Romania.

Mobile data usage is increasing in the Baltic region. In Lithuania there were 413,700 subscribers of GPRS and EDGE services as at July 2005, compared with 341,120 subscribers of mobile data services as at 1 January 2005. Estonia also experienced strong growth in mobile data services, with a 17% increase in SMS messages sent in 2004 and a 150% increase in the number of GPRS users in the same period. The operators are promoting the use of higher-margin mobile data services for two reasons; to compensate for reductions in voice tariffs and to increase ARPU as although the mobile voice markets are reaching saturation, the mobile data sector is still in the growth stages of market development. The introduction of additional content such as mobile TV in Lithuania, and the eventual introduction of high-speed third generation services in all three countries will have a positive impact on mobile data usage. The introduction of mobile applications such as email and services that use mobile phones to monitor the status of cars and houses in Estonia highlights the increasing potential of the mobile applications market. The Russian mobile applications market is developing: there are approximately 100 distribution companies providing or promoting content, and about 40 content providers. The majority of them develop their own content while a few purchase programs from foreign companies.

Strong broadband growth has been recorded in all five countries in the Central European region the highest growth rate attributed to the Czech Republic, where the number of ADSL connections increased sixfold in 2004 to 101,000. However broadband penetration in each of the countries remains below the EU average. Strong growth has also been recorded in the Balkans, with annual growth rates of 95.19% to 382,783 broadband connections in Romania, 584% in Croatia to 30,550 connections, 300% for ADSL in Greece to 88,400 subscribers and 547% increase for broadband in Macedonia to 5,530. In the CIS region broadband penetration grew strongly in Belarus, with penetration increasing threefold in the capital, although the increase came from a small user base. Broadband penetration is very low in Moldova but is growing as new operators launch services for cable broadband and WiFi. The situation is the same in Russia where future broadband penetration holds much potential as current penetration levels were less than 1% in 2004.

WiMAX services are growing in Russia. In May 2005 Moscow-based operator MediaNetworks launched a WiMAX-specification network in Nizhny Novgorod. Major alternative operator Golden Telecom is also reported to have launched a WiMAX-specification network. Another operator, Prestige Internet holds a licence to provide wireless broadband services in 29 major Russian cities and launched services by end-2005 and plans to expand services to all 29 cities by end-2007. The operator is 50% owned by Japanese firm Sumitomo. The increasing availability of broadband offerings is expected to significantly drive broadband uptake.

Cyprus has made the early progress in convergence as it offers a full Video-on-Demand broadband TV service with an Electronic Program Guide, email and web access that is available via an ADSL connection and set top box. This is beyond what many other countries in the region are offering but gives a glimpse at what may be in the near future due to the increasing prevalence of ADSL in the region.

Digital TV is in the nascent stages of development. Poland is the most advanced Central European country in terms of developments with trials launched and others to be launched soon. Broadband TV is still in its infancy due to low penetration rates although Poland has a large user base. Public broadcaster TVP launched an interactive TV pilot in May 2005 offering TV content online. Slovenia was the first to launch IPTV services in September 2003. Sistema in Russia officially launched its IPTV service under the brand “Stream TV” in July 2004.

[E22] Russia’s increasingly visible internet market is noted for its growth. Broadband, while in the nascent stages of development, is growing in availability as operators launch services over modernised networks. ADSL, cable and FTTH/FTTB-based services are available although the penetration level of all forms of broadband is still low. Wireless broadband deployments are becoming increasingly commonplace, with a number of large scale WiFi and WiMAX deployments underway. The growing broadband base has also resulted in the launch of IPTV services, with Russia one of the first countries in Eastern Europe to launch such services. IP-based triple play services are available from operators with sophisticated networks. Digital cable TV services have been offered for some time. Satellite pay TV services are available and digital terrestrial TV (DTTV) services have been launched.

But probably the most uniformly dynamic telecoms sector across the whole Eastern European region is the mobile sector. The mobile industry continues to grow despite maturing markets in some regions. In saturated markets the good times of high growth will become to harder to imitate during 2007, with revenue growth to be centred on encouraging migration to postpaid plans and 3G services to offer desirable mobile data and content.

The Czech Republic now has the highest mobile penetration out of the five CEE countries, a position once long-held by Slovenia. Deutsche Telekom has strengthened its presence in the region, following increased ownership of a major Polish network operator, a move which would allow it to offer the T-Mobile brand in the Polish market.

As mobile penetration in all five central countries is at or near saturation, operators are now looking to improve ARPU levels by migrating users to postpaid tariffs and 3G services. However 3G is not all it has shaped up to be, with Vodafone Czech Republic halting the rollout of its 3G network, believing the benefits do not justify the cost.

In the Baltic region, mobile subscriber growth in all three countries, despite saturated markets, suggests multiple SIM card ownership. Numerous Mobile Virtual Network Operators (MVNO)s offer services in each country although so far they have made little impact due to the short time they have been offering services. Mobile data and content is also being sought to create new revenue growth opportunities. Third generation and HSDPA services are available in each country although widespread usage will be limited for the next two to three years when 3G-capable handsets become more widespread. Mobile content available includes streaming mobile TV and mobile music in partnership with record companies. SMS-based mobile commerce (m-commerce) services are available. Lithuania's largest mobile operators has launched a mobile digital signature offering that is compatible with conventional Public Key Infrastructure products and has concluded agreements with certificate authorities to provide electronic certificate services.

In the Balkans, strong growth has been recorded across most mobile markets, although low annual growth rates in Bosnia and Greece suggest saturated markets. 3G will become increasingly important in the near future as the focus shifts to mobile data and content usage. However widespread uptake will be challenged in the short/medium term by the lack of desirable mobile content, lack of awareness/familiarity with mobile content services and penetration of 3G-capable handsets. Commercial 3G services launched during 2006 were witnessed in Romania and Bulgaria, with HSDPA services launched in Romania, Bulgaria and Croatia. Romania's third and fourth UMTS licences were awarded in October 2006, with an established CDMA operator and the country's second largest cable operator emerging victorious.

In CIS area, third generation mobile licences in Russia moved closer towards reality in October 2006 when the State Radio Frequency Commission announced it would offer an unspecified number of concessions in the frequency spectrum bands. Ukraine's regulator released plans in April 2006 to award a second 3G licence by 2007. Mobile penetration levels in all four countries are still growing rapidly despite approaching maturity. Consequently the major Russian mobile operators have expanded internationally in search of new revenue growth opportunities. Despite attempts to expand into Asia, the Middle East and Eastern Europe, most success has been found within the CIS region.

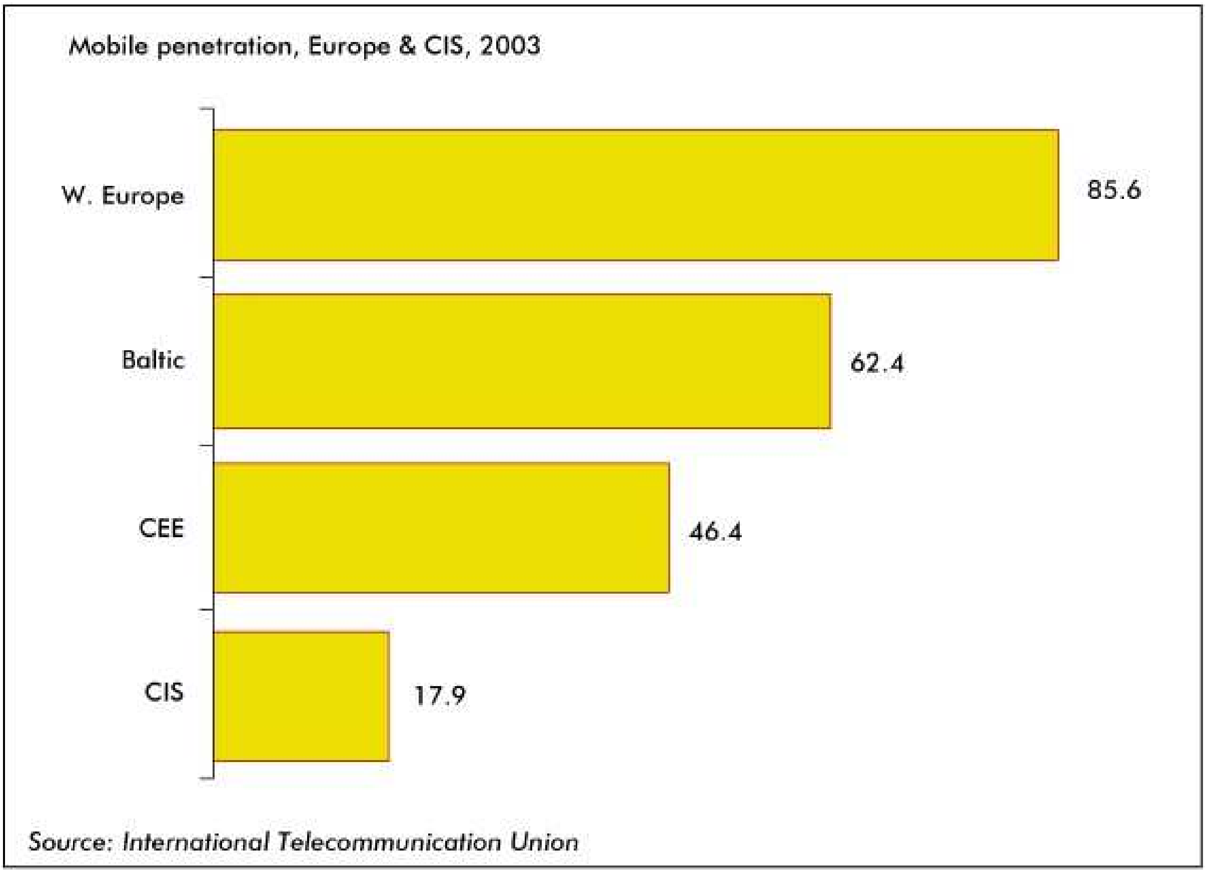


Figure 5-19 Mobile penetration in Europe and CIS

As it regards the internet market, the entrance of the new member countries from the Eastern Europe (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia) in the EU, in May 2004, increased pressure to open markets to competition.

[E23] New EU members are also upgrading their telecommunications infrastructures to compete with other EU countries. There is also a fledgling broadband market in Eastern Europe, with about 300,000 subscribers in Hungary and more than 1 million in the region as a whole. Declining costs are making broadband more accessible. DSL costs are down more than 20% in Hungary, for example, and rising internet penetration will expand the potential market for broadband. Broadband access revenue could reach $1.8 billion by 2008.

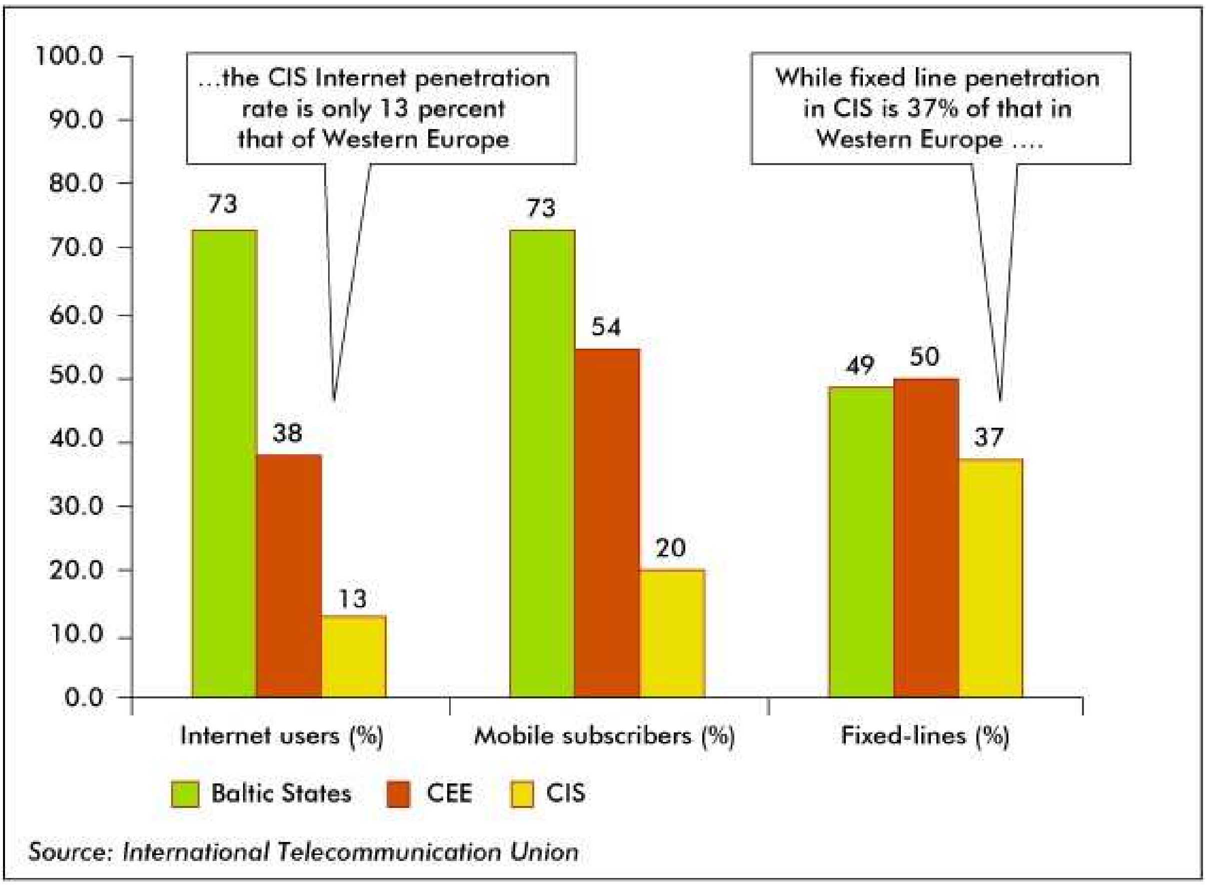


Figure 5-20 Internet, Mobile and Fixed-lines penetration in Eastern Europe

A factor moderating telephone subscription growth in Eastern Europe (including the republics of the former Soviet Union) is the declining population. Even though landline penetration has been increasing, the number of landline subscribers has grown at low single-digit rates. Russia is the dominant country in the region, with 39 million landlines, representing 41% of the total. The growing demand for Internet access is creating a demand for landlines. Internet penetration in Eastern Europe reached nearly 19% in 2004 from 10% in 2001. In 2008, internet penetration could reach 31%.

As it regards the wireless market, it added 15.5 million subscribers in 2004, reaching 110.2 million. The wireless market surpassed the landline market in 2003 and widened the gap in 2004, when it was 15.8%. In 2000, the Czech Republic, Estonia and Slovenia became the first countries to have more wireless than landline subscribers. Albania and Hungary joined that group in 2001. By 2008, wireless subscribers will outnumber landline subscribers in most countries in the region, with wireless subscribers totaling 162.2 million, or 47.4% more than landline's 110 million Russia retained its position as the country with the most wireless subscribers, growing from 25.0 million to 30.0 million in 2004.

Wireless penetration averaged 28.0% for the region in 2004, up from 24.0% in 2003. There are wide disparities in penetration among countries. In the Czech Republic, Hungary and Slovenia, for example, more than 90% of the population subscribes to a wireless service, among the highest percentages in the world. Estonia has a penetration rate above 80%, while Lithuania and the Slovak Republic have penetration rates above 70%. In Russia, the largest wireless market in absolute size, penetration was only 21% in 2004, while in Poland, the second-largest market, it was 54%. By 2008, the penetration rate for the region is projected to reach 41.4%, up from 28.0% in 2004. The Czech Republic is expected to reach greater than 100% penetration, with some people having more than one phone. Croatia, Estonia, Lithuania and the Slovak Republic will join Hungary and Slovenia as countries with wireless penetration of more than 90%.

In Appendix A, table 5 shows the broadband penetration of the internet services among the population and the growth of this technology in the last 7 years (2000-2007). The same table shows also the percentage over 1,000 people of the diffusion of radios, TVs, mobile phones and Personal Computers.

5.3.7 Cost Comparison with traditional Network Technologies

[E21] The ascension of the 10 last EU member states marks a new era in Eastern Europe, as the countries in the region integrate themselves with their western neighbours. Requirements to the EU and World Trade Organisation (WTO) have been major influence behind liberalisation in the region. As a result of liberalisation prices for services have come, resulting in increased uptake of new services such as broadband. The mobile market in the region is also facing increased competition as an increasing number of operators have to find new sources of revenue due to maturing or saturated markets. This too has led to the introduction and uptake of mobile data and content applications.

Privatisation of the Russia's state-owned telecoms group Svyazinvest is underway as in September 2005 plans to privatise the telecom operator were submitted to the government for approval. The privatisation of Svyazinvest is significant as it holds controlling stakes in all seven “mega-regional” operators that dominate their respective markets but require upgrades to infrastructure. 2005 was also the year of privatisations for other countries in the region. In 2005 Bulgaria privatised its remaining 34.6% state-owned stake, Montenegro privatised its remaining 51.12% majority stake and Albania privatised a 76% majority stake. Bosnia privatised its incumbent by mid-2006 and Romania completed privatisation of its remaining 45.99% stake in 2006. Serbia is moving to privatise its 49% stake in its mobile operator but has been hampered by an ownership dispute.

[E24] While the number of broadband operators is increasing quickly, prices remain high for a large segment of the market (a factor that is inhibiting it from reaching its full potential). As a result, operators are coming under increasing pressure to lower prices for access and increase bandwidth availability.

Other broadband access technologies, such as fixed wireless, satellite, and powerline, remained negligible (in 2003). For the analysts of the sector, these are mainly niche markets and should not take significant market share from the more widely available DSL and cable segments. Still, fixed wireless services remain popular among small and medium-sized businesses in some CEE countries where DSL or cable are not yet widely available and where leased lines remain too expensive.

From the other side (the electric sector), in the last years tariffs are substantially grown. [E25] Increasing the electricity tariffs for private consumers to cost-covering levels has been a very sensitive issue for all transition countries. The likely negative social consequences are the central argument why the necessary tariff corrections have not yet been implemented in some country (like in Ukraine) by the political decision makers. Basic data of one survey was used in evaluating the impact of possible tariff increases on the household expenditures of different income groups. The findings confirm that an electricity tariff increase up to the level which would cover "officially" measured costs, as defined by the Ukrainian electricity regulatory authority, would not cause severe social problems. However, further increases up to a level, which would cover the "true" costs should only be realised in steps.

If the prices of the electric supply increase too much, probably also the prices of the PLC-based services could result few convenient in comparison to the prices of the other technologies. While in fact the electric grid in Eastern Europe is very old and partly have to be reconstructed, services linked to telephone and cable lines, such as wireless and mobile technologies, use more recent and modern network infrastructures, allowing a better exploitation of the transmission way.

Some prices of the traditional services (ADSL, Telephone, IPTV and Wireless) sold in Eastern Europe have been shown in the section 5.3.5.1.4 (*Internet service providers*) and for convenience they are brought back below:

- Telephony (unlimited) & TV at € 27
- Telephony & Internet (unlimited 16 Mbps) at € 32
- All in One ("triple play") at € 35-40
- 128 Kbps Wireless solution at € 27 (plus € 94 of installation cost)
- 512 Kbps Wireless solution at € 67 (plus € 134 of installation cost)
- 1024 Kbps Wireless solution at € 121 (plus € 188 of installation cost)

The price of the PLC technology, as it has been said in the section 5.3.5.2.2 (*PLC cases in Romania*) can wander around € 7 for a phone and 64 Kbps internet access.

5.3.8 Barriers and future Opportunities for the PLC Technology

There are positive and negative aspects for the development of the PLC technology in Eastern Europe, but before describing some of them, it can be useful to see how much the Eastern European countries are investing in the telecommunication sector.

[E26] The European IT Observatory carries a detailed report showing the results of a survey of IT and Telecommunications (ICTs) investment, use and policies in Eastern European countries. Countries covered by the survey include Russia, Estonia, the Czech Republic, Hungary, Poland, Slovakia and Slovenia.

The first chart shows absolute levels of IT investment spend per capita. This is a good basic way of assessing a country's existing preparedness for the Information Society and the global networked economy. As might be expected, all the Eastern European countries surveyed are well below the average for Western Europe, but two countries, Slovenia and the Czech Republic, have a higher level of investment than Greece. Overall, the level of existing investment in Eastern European countries is less than one quarter that of the West.

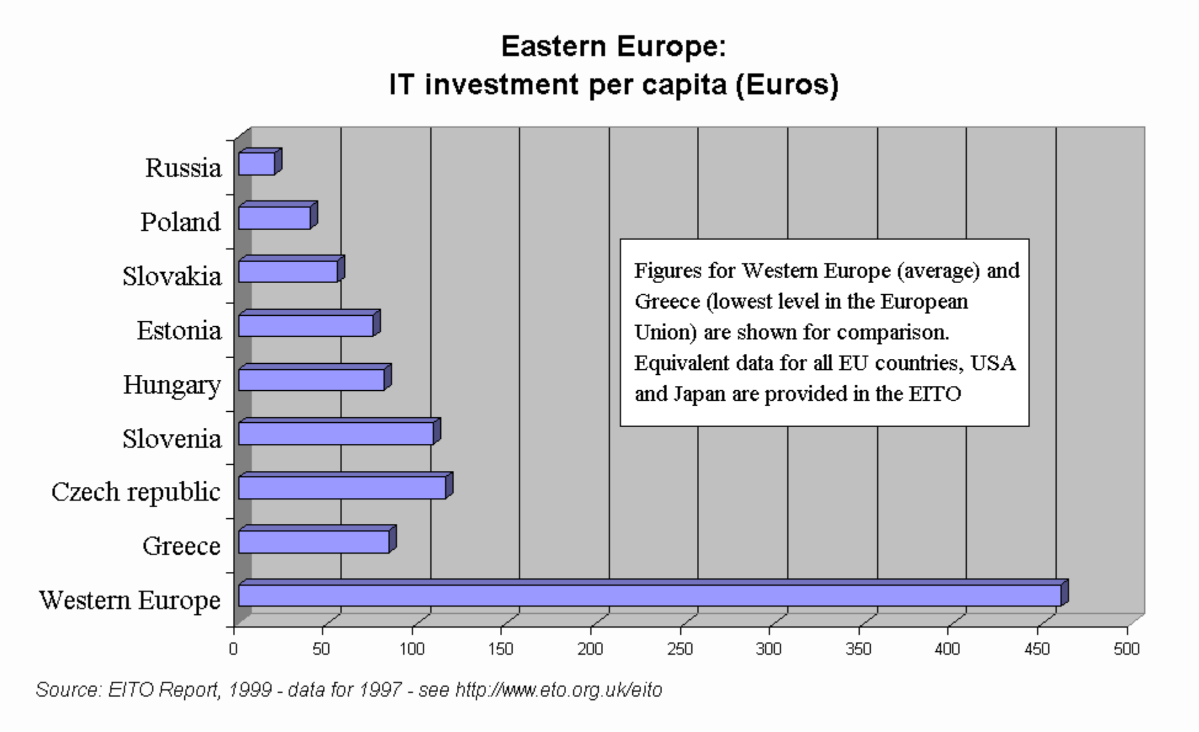


Figure 5-21 IT investment per capita in Eastern Europe

The second chart shows relative rates of investment: IT spend as a percentage of national GDP (Gross Domestic Product). This shows a quite different pattern, reflecting intensive efforts by Eastern Europe countries to catch up with the West in their ICT investment. Estonia and the Czech Republic are investing at a rate higher than the Western European average, with Slovakia and Hungary also investing at close to the Western rate. Six out of the seven countries surveyed show a higher spend rate than Greece.

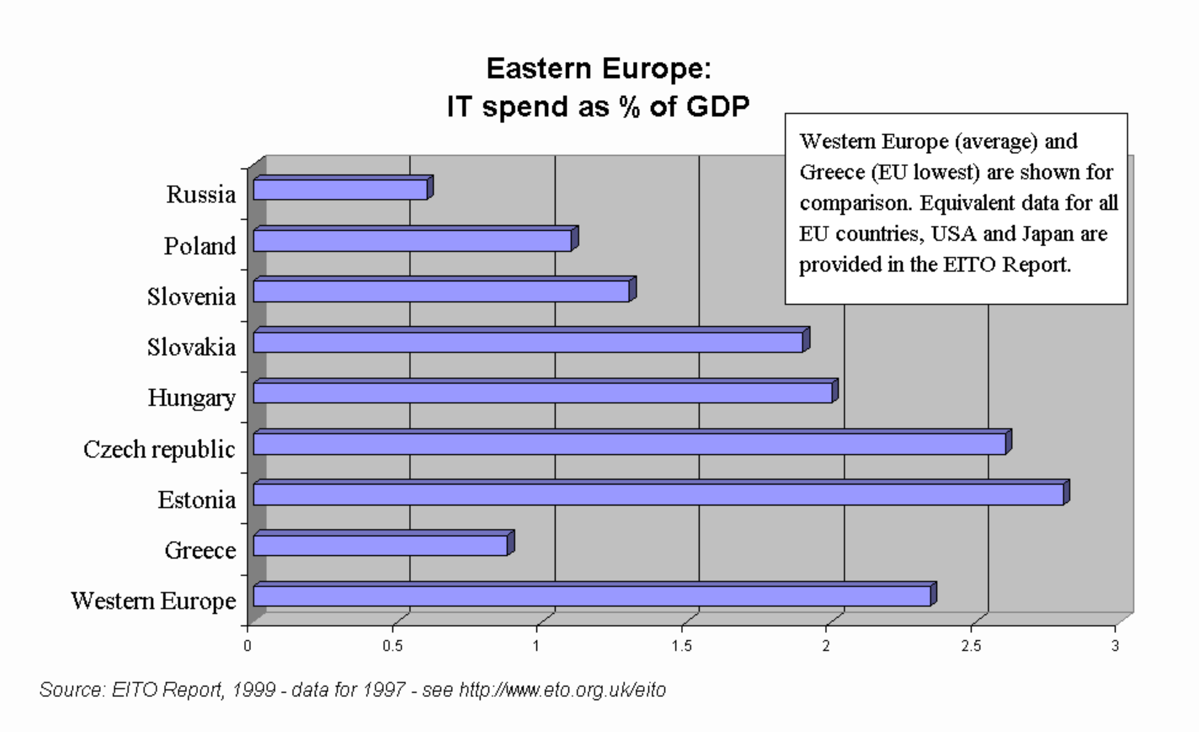


Figure 5-22 IT spend as % of GDP in Eastern Europe

5.3.8.1 Barriers

The greatest barrier for the diffusion of the PLC technologies in Eastern Europe is the status of the electric grid, both from the point of view of the infrastructure (it is often very old and partially damaged), both from the point of view of the management: in almost all the countries of the Eastern Europe, the electric grid has been for a lot of time of exclusive ownership of the state (especially in the ex-communist countries), that has left the prices low. With the opening to the capitalism, many citizens would be now unable to pay a “market” price for the supply of the electrical service. Nevertheless the increasing capitalization of the sector and the need of private funds for improving the conditions of the electric grid, have necessarily to increase the prices of the electric energy.

[E27] Worried by resurging inflation, the Russian government scrapped its plan to allow the Federal Energy Commission to fix tariffs for gas, power, and railways.

Electricity throughout the former Soviet bloc is heavily subsidized. Governments are reluctant to raise prices to realistic levels lest they incur the wrath of their impoverished subjects and reignite dormant inflation. Fuel prices, government taxes, and variable costs, such as labor, have been rising steeply in the last decade but the electricity behemoths' ability to amend their tariffs to reflect these is politically curbed.

The Russian Unified Energy Systems electricity monopoly was allowed to up its prices this year by a mere 14%, barely the rate of Russian inflation. Its chances to attract the $50 billion in investments it says it needs in the forthcoming 10 years are slim as long as it continues to charge its customers (both wholesale and retail) a fraction of the cost of electricity its West European counterparts charge theirs. A restructuring plan, approved by the government in May 2001, is going nowhere. The sale of loss making generating plants (even at bargain basement prices and to insiders) is impossible without a massive (and massively unpopular) boost to electricity prices.

Vociferous protests in Croatia last month forced the government to shelf a scheduled 9% hike in the price of electricity for domestic consumption. The IMF is displeased with the government's stranglehold over the energy sector and is pushing for liberalization. Slovakia's news agency, TASR, reported that thousands of members of the Trade Unions Confederation demonstrated in Bratislava against proposed budget cuts and increases in regulated prices, including electricity's.

Still, consumers will not be able to buck the trend forever. Even the rich countries of the region are facing already unsustainable electricity subsidy bills. The Slovenian news agency, STA, reported that Slovenian producers of electricity and natural gas warned that (once the domestic market opens to foreign competition) they will be at a disadvantage due to the unrealistic electricity "price model".

Yet, liberalization and privatization have acquired a bad name after the debacles in California and elsewhere in the world. Moreover, electricity generation depends on a free market in fuels: a rarity in central and Eastern Europe. Prices cannot rise above the increase in net disposable income.

As infrastructure crumbles, replacement costs soar. The Albanian Daily News reported that in 2002, Albania's electricity self-sufficiency decreased from 66% to 46%. Power cuts of up to 18 hours a day are not rare. The same applies to Kosovo, where electric storms demolished the local generation plant and to Montenegro.

The dependence of many countries in transition on decrepit and antiquated nuclear power plants causes friction with the European Union. Austria and the Czech Republic have clashed over the much-disputed Temelin facility. Croatia and Slovenia are locked in a bitter dispute over their shared ownership of the Krsko nuclear plant. Lithuania derives 78% of its power the atomic way. Slovakia gets 53% of its electricity from its reactors, Ukraine 46%, Bulgaria (in the throes of a controversial plan to modernize its nuclear works in Kozloduy) 42%, Hungary and Slovenia 39%.

Nor can pure market mechanisms solve the problem. In 2001, hundreds of Romas, having been cut off the grid for unpaid bills, demonstrated in Plovdiv and in Lom, Bulgaria. Remote and rural areas are poorly catered to even by state-owned utilities, let alone by privatized ones. On the same year, the Romanian government restructured Electrica, an electricity utility, but wisely retained ownership of the long-distance distribution network.

Bulgaria is emerging as an energy hub. The cabinet is drafting a bill which calls for far-reaching liberalization. Subsidies for both electricity and heating have be phased out by 2006.

Bulgaria is slated to establish a regional energy distribution coordination centre under the auspices of the Stability Pact. Bulgaria covers 40-50% of southeast Europe's entire electricity deficit every winter. It also exports electricity to Turkey and even to Romania. Italy and Greece are negotiating a transit agreement which will permit the former to import Bulgarian electricity through the latter's territory. Bulgaria is not the only exporter. Romania, Croatia and even Bosnia sell power.

Aware of this, the World Bank has recently increased the amount of money allocated to energy projects. In Albania alone, it has earmarked $16 million to reconstruct three hydropower plants and another $1 million to install electricity meters in Shkoder, in the north. Even the pariah Republika Srpska, the Serb part of Bosnia-Herzegovina, stands to get $90 million to construct an electricity grid.

Multilateral funds will not be enough, though. Private capital is essential. Macedonia has just retained Austria's Meinl Bank to act as consultant and prepare a sales strategy for the its national electricity company ESM. That won't be easy.

The more venal and xenophobic the political class, the less welcome are foreign investors. The Moldovan government seeks to annul the sale, in 2000, of three electricity distribution companies to Union Fenosa, a Spanish energy group. The World Bank was furious. Moldovan announcements of massive exports of electricity to Romania were greeted with derision by the alleged client.

Private investors, though, seem to have lost their appetite for bloated state monopolies. According to Albania's Ministry of Industry and Energy, even a giant like General Electric prefers to build 10 small thermal power plants in the country's larger cities. Other investors are interested in 23 hydropower plants about to be privatized. Some utilities choose to tap the capital markets. Romania's Hidroelectrica launched a Eurobond issue of more than 120 million euros to improve hydropower equipment. Parex Bank and the Baltic investment company, Suprema, organized a consortium to lend $25 million to reconstruct one of Riga's thermoelectric power stations.

Electricity is no longer merely a national affair, but, rather, a regional one. A memorandum regarding the establishment of a southeast European energy market and its ultimate integration with the European Union's was signed in Athens by ministers from Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Greece, Macedonia, Romania and Yugoslavia. These represent a market with more than 55 million consumers who will be able to buy power directly from generating utilities, pledges the document.

But this touches upon a second conundrum. Households and firms don't pay their bills. The threat of widespread social unrest prevents the utilities from cutting them off. Better metering is one solution. The InvestRomania business daily reports that the national electricity company, Transelectrica, backed by the European Bank for Reconstruction and Development, signed a $20 million contract with the Swiss firm Landis&Gyr to install remote counters of wholesale electricity. The hope is that with resumed growth and rising incomes this problem will vanish together with the currently common blackouts and brownouts.

5.3.8.2 *Opportunities*

[E28] Though still a promise largely unfulfilled, the countries in transition could now leapfrog whole stages of development by adopting novel technologies and through them the expensive Western research they embody. The East can learn from the West's mistakes and, by avoiding them, achieve a competitive edge.

Technology is a social phenomenon with social implications. It fosters entrepreneurship and social mobility. By allowing the countries in transition to skip massive investments in outdated technologies, the cellular phone, internet, cable TV, and the satellite become shortcuts to prosperity.

Poverty is another invaluable advantage: with the exception of Slovenia, Estonia, Croatia and the Czech Republic, the population of the countries in transition is poor, sometimes inordinately so. Looming and actual penury is a major driver of entrepreneurship, initiative and innovation. Wealth formation and profit seeking are motivated by indigence, both absolute and relative. The poor seek to better their position in the world by becoming middle-class. They invest in education, in small businesses, in consumer products, in future generations.

One of the eastern country that is much more investing the last years is the Romania.

[E29] “As EU member state, Romania aims at developing the information society as basic pillar of the Lisbon strategy enforcement, but also within the central and local administration, in view of better public services”, said Prime Minister Calin Popescu-Tariceanu.

"In this respect, Romanian Government promotes not only the development of the IT&C sector as one of economy's sectors, but also the presence of these applications in the structures of the central and local administration, the creation of efficient bridges between the big cities and the local communities", Tariceanu underscored.

According the Prime Minister, Romania is now one of the most dynamic markets in IT and communications. Despite this, Tariceanu showed there are still important gaps between Romania and the other member states of the Union. In his opinion, the gaps consist not only in infrastructure, but also in the fact the IT networks concentrate around the big towns and less in smaller localities or rural areas. In this context, the prime minister pleaded for avoiding a technologic polarization.

The head of the Government reminded that 246 electronic networks of the local communities would be set up by end-2007, which will offer citizens online information and services through the project "Knowledge-based Economy". This project's objectives are the expansion of access to technology and advanced communications, improvement of computer usage by people and promotion of online public procurement system and electronic trade.

The prime minister also underlined the importance of school computerization projects, the programme "A laptop for each pupil", and of the programme Power Line Communications, aimed at offering a cheap internet alternative nationwide.

"Romania aims at playing an active role in the implementation of the plan for supporting the use of IT technology and communication and in the development of a competitive informational society, a plan implying measures to promote the e-trade, e-solutions, e-education and e-health, the objective being to bridge the current gaps", Tariceanu underscored.

Prime Minister Tariceanu further appreciated that the development of IT&C simultaneously depends on new services provision and the growth of the people and companies' awareness with respect to the benefits of IT society.

Romania has shown therefore interest for the PLC technology, especially to reach the rural areas of the country, offering new services to the population.

[E30] Nevertheless, broadband networking over power lines (whether in the home or in the wider area) remains a niche market, but it may prove a boon to power utilities. A fringe benefit of using a region's power grid to carry broadband access networks is that it makes the electricity distribution and monitoring system visible to managers as never before.

BPL (Broadband over Powerline) has the general blessing of governments and a reservoir of underdeveloped markets in Eastern Europe. But, according to Vamsi Sistla, ABI Research's director of broadband, digital home and media, such disruptive technologies, while they address emerging markets, can also benefit legacy businesses such as power utilities in the industrialized world. "Innovation in powerline technologies may or may not add to power utilities' revenues immediately", he says, "but the cost savings they enable will certainly help their bottom lines".

Take the ability to remotely monitor electric meters. Traditionally, a human "meter reader" would visit every customer's household to log power use manually. Even with the later development of "drive-by" meter reading, a driver, a truck and some specialized equipment were required. All of those cost money and time, and ultimately drive up prices.

Grafting a broadband network onto the power grid, on the other hand, means completely remote, automated meter reading, as well as instant reporting of outages and system failures. "ABI Research believes the utility industry should focus on these low hanging fruits, even more than building BPL capabilities to generate additional revenue", notes Sistla.

So, at the moment, the PLC technology seems to have more future to carry narrowband services rather than broadband connections.

Nevertheless as we see in the preceding paragraphs (especially in 5.3.5.1.1 "*Internet service providers and Media broadcasters operators*" and 5.3.5.1.2 *"VoIP and IP-TV service providers"*), in Eastern Europe there is also the wish of broadband multimedial services (such as IP-TV) and in general this type of services is destined to increase with the years.

[E31] In this optics, on May 2007, it has been approved a technological "bridge" between Italy and Holland to favor the development of the telecommunication wireless grid in Italy and in Albania with the purpose to reduce the digital divide. The operation started by the Dutch group Hopling Technologies, that produces equipments for WiFi and WiMax networks, and it has been signed with Rew Networks, that has gotten the license for Italy and Albania of the whole range of the hardware and software produced by the Dutch society.

Rew is an American society located also in Italy, that plans and realizes hybrid networks. The core business of the company is the development of solutions based both on the use of wireless technologies (WiFi Mesh and WiMax), and on the use of wired technologies over electric grid, like the BPL and PLC technologies.

5.3.8.3 Conclusions

The possibilities of the distribution of the PLC technology in Eastern Europe may be considered favorable in some regions. In the eastern countries there is not at the moment, a real thirst for broadband services or fast connections to the internet (although the television over IP protocol services are very distributed).

Many countries of the eastern area need instead to invest in telecommunications to reach (or at least come close to) the level of the western countries. The expansion of the European Union to the eastern countries will increase this need to draw nearer to the capability of western Europe. Probably because of the ex-communist nature of many eastern countries, local governments are dedicating high attention to supplying infrastructure to rural areas.. In this light, the use of the PLC technology can be of great interest, especially considering the low availability of funds of the local administrations and above all the low prices that Eastern European citizens are used to pay. While urban areas in Eastern Europe have a well developed telecommunications infrastructure, financed in part by the EU and other public funds, the rural areas have not been addressed adequately. A main obstacle to PLC application may the antiquated condition of the electric grid. Important economic efforts need be done to modernize the electric distribution grid (or to reconstruct them in the areas devastated by the war

5.4 Africa

5.4.1 Region covered

The United Nations Economic Commission for Africa (UNECA) divided the African continent in 5 macro-regions, which are:

- North Africa (Algeria, Egypt, Libya, Mauritania, Morocco, Sudan, Tunisia)
- West Africa (Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo)
- Central Africa (Cameroon, Central African Rep., Chad, Congo, Equatorial Guinea, Gabon, Sao Tome and Principe)
- East Africa (Burundi, DR Congo, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Seychelles, Somalia, Tanzania, Uganda)
- Southern Africa (Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Zambia, Zimbabwe)

Nations that belong to the same macro-region often cooperate all together, also independently from the other African countries, in the improvement and development of their region, under varied sectors: agriculture, telecommunications, technology and many others.

Figure 5-23 Africa

5.4.1.1 Electrical coverage

One of the most important factors to be considered, before being able to speak of powerline communications in Africa, it is the situation of the electric energy in Africa and the extension of the relative net of distribution.

The African electric grid is still very limited. In the last 10 years, many African countries have a lot invested in this sector and today, many of them are self-sufficient, in the sense that they produce how much they consume. The problem consists in the limited expansion of the electric grid: only the 2% of the African population are reached by the electric line. In the most greater part of the cases they are only some town buildings to be provided of electricity. Moreover, the increasing demand of electricity, forces many countries to rationalize the distribution, serving their own territory to alternate schedules. The frequent actions of vandalism then, caused by poor people that to gain some penny, removes pipings, poles, electrical cables, force a lot of nations to waste many money to repair infrastructures already built, removing precious funds from the cash of the state. The only (or one of the few) positive note, is the collaboration that the most greater part of the african states have chosen as road for the development. In particular, countries as Congo, Cote d'Ivoire, Egypt, Mozambique, Zambia and above all the South Africa, exports a lot of energy to the neighboring countries.

A case apart is represented really from the South Africa. Among the African nations in fact, South Africa is the more advanced country and the one with the vast electrical and telephonic coverage. With its 2 nuclear plants, the South Africa is even the fifteenth world power producer, as you can see from the chart in Appendix B.

5.4.1.2 Telephone coverage

In the last years (mostly from 1998, when the economic politics has become more liberal), Africa has actuated notable progress from the point of view of the infrastructure of the telecommunications, thanks also to the attraction of foreign investments. The African countries have understood that the economic development is strongly conditioned by the capillarity of the telecommunication grid and they have started, each country according to his own possibilities, projects for the connection with other african countries and with the rest of the world.

Nevertheless, on a world-wide level, Africa is still to the last position as it regards the development of the telecommunications infrastructure. The average teledensity is barely on 2% and almost all telephones are situated in the urban centres.

In many countries, the requests of activation of a telephone line overcome the 700,000 units and the expectation time is also of 10 years (like in the Algeria). Also the public telephones are not so much. In requital, the mobile telephony is very developed and it succeed to cover almost all the territory. In the last decade there have been a lot of privatizations and new telephone operators have risen, that should increase the competition, advantaging the end users. Nevertheless the most greater obstacle to the communication are, currently, the high tariffs, so much that it is exploded newly, the phenomenon of the "miskin", term used in Ethiopia to refer to the small beeps exchanged among the mobile telephone, at the purpose to exchange a conventional information, without the need to effectuate a real call.

[A01] It is a tactic born out of ingenuity and necessity, say analysts who have tracked an explosion in miskin calls by cash-strapped cell-phone users from Cape Town to Cairo.

The beeping boom is being driven by a sharp rise in mobile phone use across the continent.

Africa had an estimated 192.5 million mobile phone users in 2006, up from just 25.3 million in 2001, according to the U.N.'s International Telecommunication Union. Customers may have enough money for the one-off purchase of a handset, but very little ready cash to spend on phone cards for the prepaid accounts that dominate the market.

Africa's mobile phone companies say the practice has become so widespread they have had to step in to prevent their circuits being swamped by second-long calls.

"We have about 355 million calls across the whole network every day," said Faisal Ijaz Khan, chief marketing officer for the Sudanese arm of Kuwaiti mobile phone operator Zain (formerly MTC). "And then there are another 130 million missed calls every day. There are a lot of missed calls in Africa."

Also the internet connectivity has sustained, in the last 10 years, a notable growth: at the end of 1999, only Congo and Somalia didn't have still a local internet access. The most connected region results the Southern Africa, followed by the North Africa, the East Africa, the West Africa, and finally the Central Africa.

Despite the growth, however, internet connectivity remains chiefly limited to the capitals and the bigger urban centers, in which are found the most greater part (and in some cases, the only one) of the POPs. This choice (forced) risks seriously to increase the already great gap among the urban population and the rural one, that is around the 80% of the whole African population.

In the Appendix B, it can be seen the number of telephone main lines, mobile cellular and internet users for every African country.

5.4.1.3 Others coverages

5.4.1.3.1 Fiber

Africa is trying to exit from the isolation in which was found up to last century, investing a lot of resources in the development and in the expansion of its communication grid. Many countries have undertaken ambitious projects and they are evaluating the different possibilities offered by various present technologies on the market today. Because of the low diffusion of televisions and even of radio (lack of electricity forces people to use only batteries, too much expensive for the most greater part of the Africans), transmissions by aether are few like the presence of cable lines. Home satellite dishes are enough diffused instead. The great extension of the African territory and the distribution of the population in fact, don't facilitate the use of transmissions by cable or by aether, because of the high costs of infrastructure to cover the territory. For this reason, satellite communications system is seemed the most adapted. However, in the last years, also this technology has shown its problems, especially the economic ones, that have slow down the push to still invest in this direction. The greatest business companies instead, situated mostly in South Africa and in the mediterranean Africa, are pushing more and more, for fast connections with the rest of the world: from here, the increasing interest toward the fiber optics.

[A02] The Ethiopian Telecommunications Corporation (ETC), for example, has installed a new R503-million (EUR 51.6 million) fibre-optic network to boost international communication flows and lower costs. The fibre optic system will cost the country R740,000 (EUR 76,045) per month, compared with the monthly R1.1-million Ethiopia was paying for satellite operations. Business leaders say the high cost of telecommunications in Africa is an impediment to investment in the world's poorest continent, where internet traffic often travels over creaking satellite connections. Because the Horn of Africa country was landlocked, it had to depend on the goodwill of neighbour Sudan for international connectivity. The network stretches over 983 km on Ethiopian territory and merges with Sudan's Sudatel at the border town of Gedarif. ETC currently provides 900,000 landlines and has 1.1-million mobile lines. ETC said the potential for expansion in the country was unlimited. Ethiopia has been connected to the international telecommunication network since 1987 through a satellite earth station in Sululta some 30 km north of Addis Ababa. The station does not have the capacity to handle the growing volume of information communication flows, ETC said.

Besides Ethiopia, Africa already has a discreet fibre infrastructure network.
[A03] Africa’s main fibre route is provided by SAT3. SAT3 goes from Portugal down the west side of the continent to South Africa, before becoming the SAFE cable that crosses the Indian Ocean to India itself. The map below illustrates in diagrammatic form the international transit route and the different landing points on the continent.

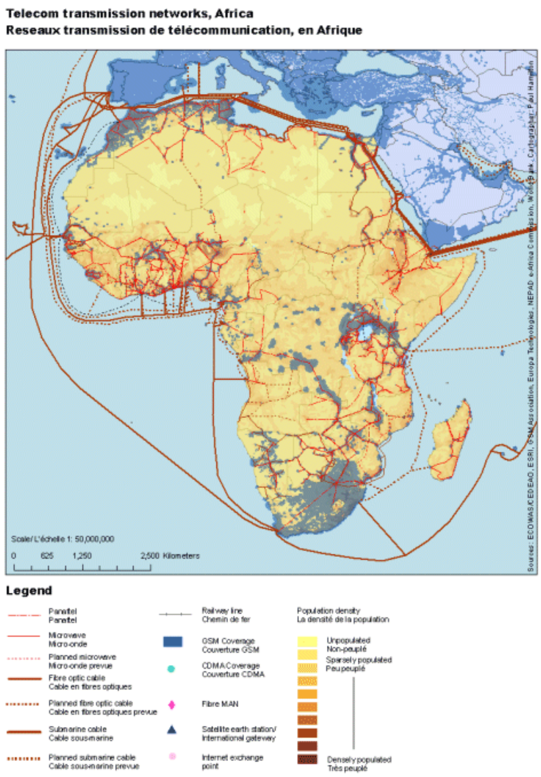


Figure 5-24 Telecom transmission networks

In addition to the EASSy project, there is a number of other proposed fibre projects including: the NIGAL gas pipeline fibre from Warri (Nigeria) to Algeria via Niger; the Reseau Boucle Nord connecting North African countries with West African countries using a circular route; the Infinity West African cable, Glo-1 (from Lagos to London) and the West African Festoon System (WAFS) connecting unconnected countries from Angola to Nigeria.

5.4.1.3.2 Wireless

In the last 5 years then, it is increasing more and more, interest toward the wireless technology and many countries, like Nigeria, look at this technology (Wi-Fi and Wi-MAX), as the optimal solution to connect million of people, spread on the whole territory. The Wi-MAX technology in particular, in continuous improvement, would be already able to connect, with an only transmitter, an area of around 50 km. This solution is evidently very attractive for the African states; however the great problem of the cost remains: currently the wireless technology is still too much expensive and besides, doesn't have a definitive standard yet. For these reasons, many African countries (like Nigeria), have shown interested, but for now, they have decided to wait that this technology will be better developed and that the prices will cheapen.

In Appendix B, it can be seen the general situation of the access to the information in the various African countries.

5.4.1.3.3 PLC Network and Equipment Statistics / Volumes

[A31] The latest OECD (Organisation for Economic Co-operation and Development) broadband statistics tell a sad tale of a widening digital divide between the developed world and countries like South Africa. According to the December 2006 OECD broadband statistics the number of broadband subscribers in the OECD increased by 26%, from 157 million in December 2005 to 197 million in December 2006. The average broadband penetration rate in the OECD is now standing at 16.9%, an increase of 3.4% over the 13.5% penetration rate a year ago. South Africa's broadband penetration rate currently sits at around 1%, something that has been achieved over 4 years. The strongest per-capita subscriber growth over the year comes from Denmark, the Netherlands, New Zealand, and Ireland. Each country added more than 5.8 subscribers per 100 inhabitants during the past year. Compare this with South Africa's yearly growth of less than 0.5% and it becomes clear that the broadband gap between the developed world and countries like South Africa is widening.

Fibre-to-the-home connections, typically providing subscribers with connection speeds of 50 Mbps and more, continue to make in roads into the broadband space. Fibre-to-the-home (FTTH) and Fibre-to-the-building (FTTB) subscriptions now comprise nearly 7% of all broadband connections in the OECD and the percentage is growing. Korea and Japan each have more than 6 fibre-based broadband subscribers per 100 inhabitants. Japan leads the OECD in fibre connections directly to the home with 7.9 million FTTH subscribers in

December 2006. Fibre subscribers alone in Japan outnumber total broadband subscribers in 23 of the 30 OECD countries. The presence of the fiber optics in Africa is very scarce, but it is in increase.

Wireless services like iBurst and satellite connections continue to struggle to win a significant market share in the OECD. Currently 98% of all broadband connections in the OECD, defined as services with download speeds equal to or faster than 256 kbit/s, are fixed line offerings. DSL is the most popular connection with 62% market share, followed by Cable modems with 29% and Fibre connections with 7%. All other broadband connections, including satellite, fixed wireless and power line communication, account for less than 2% of the broadband connections in the OECD. In South Africa around half of all broadband connections are wireless which is mainly due to the high cost and poor service offerings in the fixed line space.

[A32] Anyway, in Africa, according to Balancing Act's Voice and Data Forecasts the thirst for broadband is driving bandwidth growth. The rapid take-up of broadband in general and wireless broadband in particular has driven increases in internet bandwidth and will be the prime driver of growth over the next five years.
Additional growth from dial-up subscriptions over the forecast period to 2011 will be 689 Mbps. But growth from all forms of broadband over the forecast period to 2011 will be 43,529 Mbps, almost a tripling of bandwidth required. Wireless broadband may well be a much larger contributor than ADSL to bandwidth growth in Sub-Saharan Africa. Although ADSL dominates demand in those countries already connected to broadband, the most rapid growth will probably come from wireless broadband.

International voice traffic continues to grow at rates above the world average. Its rate of growth 23.4% CAGR for Africa and 13.8% CAGR for the world, is above the world average.
Satellite carried 45.3% of Africa's international voice traffic in 2006. Although there are a number of marine and terrestrial fibre projects that will come into use, the fall in the use of satellite will be relatively small across the forecast period, dropping to 41% in 2011 if no

further international fibre cables are built. Total Internet bandwidth supplied by satellite has dropped from 24.1% in 1998 to 11.5% in 2006. 26 countries get 100% of their international internet bandwidth entirely by satellite.

Both retail and wholesale prices for international voice traffic have dropped dramatically. Nevertheless falls in both prices remain uneven with a large number of countries maintaining incumbent monopolies that allow them to keep prices artificially higher.

[A33] Despite considerable falls in international retail calling prices in many countries across the continent and the legalisation of VoIP in key markets, the existence of the grey market remains extensive in all African countries.

There are currently eight countries where VoIP is more or less legal. 36 out of 54 countries and territories in Africa forbid the use of VoIP by regulation or by law. Of these 36 countries, 30 have only one international gateway. The remaining six countries have either licensed an international gateway to a Second National Operator (SNO) or have licensed more widely to their mobile operators.

[A34] IP-TV is seen by many as an essential service for broadband providers like Telkom to lift their average revenue per user and enhance their general service offerings, but in Africa, this service is very narrow. In countries where IP-TV is launched we generally see high broadband penetration rates and bandwidth rich environments, something that cannot be said for South Africa. For IP-TV to make business sense, high broadband penetration rates are required to achieve economies of scale. This raises the question as to whether Telkom has sufficient subscriber numbers on their 4 Mbps ADSL service, the minimum speed needed to support true IP-TV services. A further concern is the low monthly usage allowances associated with local broadband offerings. These low monthly caps will influence the potential success of a service like IP-TV, unless another solution is found. The dilemma is that standard IP-TV offerings relying on broadband access will definitely not be able to function in an environment where 3 GB monthly caps are commonplace. While there are concerns regarding usage limits and speeds for IP-TV over services like ADSL, gated communities have the advantage of rolling out fast and uncapped local networks using technologies like Wi-Fi and Broadband over Power Lines.

[A35] It is important to remember that the average total telephone penetration across the African countries is over 11% for households with fixed line phones and over 12% for households with pre-paid mobile phones. This means that vast numbers of Africans still do not have access to affordable communications. The relative rarity of internet usage is indicative of a world where access to the internet is low and expensive, and people continue to rely largely on traditional information sources (popular press, magazines, radio and television) for information. The figure from the table below gives an indication of the state of e-access and usage in the most representatives African countries.

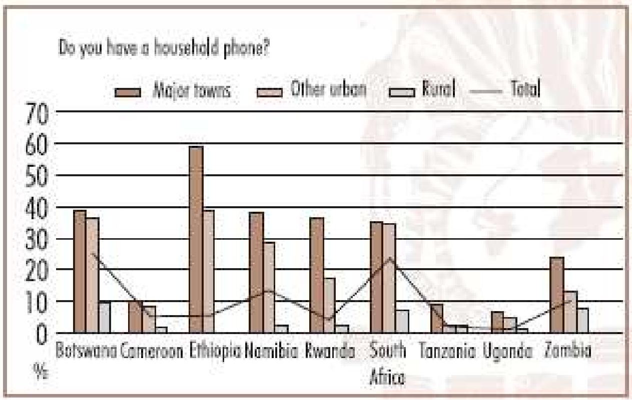


Figure 5-25 Do you have a household phone?

Botswana has the highest fixed line household penetration at 22.4%, followed closely by South Africa at 22.1%. Zambia is next at 18.6%, with Namibia at 14%. Tanzania has a fixed line penetration of 6.1%, Ethiopia just over 5% and Rwanda 4.4%. Uganda trails far behind the rest, with penetration under 1%. Unsurprisingly, penetration is far higher in metro areas than their urban and rural counterparts. Ethiopia is particularly notable in that it does not have any rural fixed line phones at all and Uganda has a miniscule amount of rural fixed line access.

Of those people with fixed access, 46% had mobile phones as well and 34% had internet access. Of those with mobile phones, 45% had fixed access as well. Of those who had internet access, 80% had mobile phones and 100% had fixed access. Clearly, in many of the low fixed penetration countries, mobile is being used to compensate for the lack of fixed access, with Uganda having a mobile penetration rate at the household level of 3%, compared to its less than 1% fixed-line penetration rate. Rwanda's mobile penetration is higher, at over 8%, even with more than 4% fixed line household penetration. In Ethiopia, on the other hand, with a higher fixed line penetration, less than half a percent of households have mobile penetration, as it can be seen from the underlying chart.

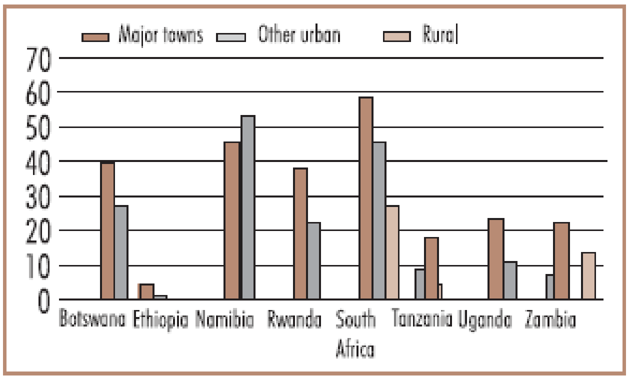


Figure 5-26 Mobile penetration by household

At the other end of the scale, South Africa has the highest mobile penetration at 32%. This is followed closely by Botswana at 23%, Zambia at nearly 18% and Namibia at over 12%. The distribution of mobile phones was concentrated in urban areas; in all countries, besides this, the drop-off between urban and rural areas is dramatic: for the majority of households, mobile phones substitute for, rather than complement, fixed line phones. Clearly, most of those who do have fixed phones (67%) complement their fixed lines with mobile phones. More than 90% of all mobile phone users in sub-Saharan Africa are pre-paid subscribers. While the growth of mobile has been dramatic and the trend is towards it being a substitute for fixed line access, it is striking that 80% and above of respondents believe that the major obstacle to increased mobile use is the cost of calls.

As anticipated, with low fixed line penetration rates and the generally high cost of both fixed and mobile services, the penetration of the internet is exceptionally low. The most useful measure of internet penetration is e-mail addresses, since access at home is entirely dependent upon fixed line access. Due to high fixed line costs, few African homes have access to internet, but many people use e-mail at cyber cafés. The highest penetration rates were recorded in South Africa at 5.7%, Tanzania with 2.4%, Namibia with 1.6% and minimal penetration rates for Uganda (0.4%) and Ethiopia (only 0.1%, where local calls are the cheapest).

Computer penetration is very low, as is per capita income, and the limited infrastructure would place a cap on internet uptake in any case. Again, within these very low internet penetration rates, the distribution of e-mail addresses was significantly concentrated in urban areas. Close to 30% of metro households have one e-mail address, twice the level of other urban areas. Less than 5% of households in rural areas had an e-mail address.

The number of household members with e-mail addresses compared to the penetration of household computers raises the question as to how they access the internet. One of the primary methods of accessing the internet is at work.

Another indicator of actual internet usage is given by the bandwidth per capita, rather than the number of users, as it shows the underlying graph.

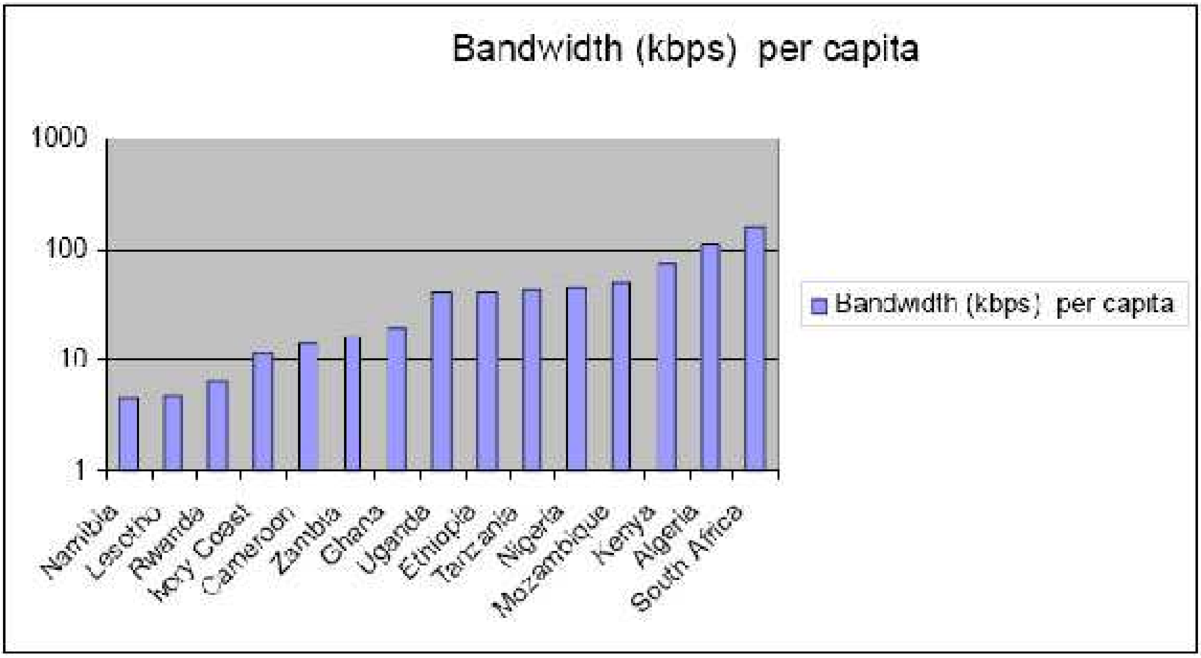


Figure 5-27 Bandwidth (Kbps) per capita

[A35] Nearly 4% of households had a computer at home. By comparison, 15.96% of households had at least one member of the household with an e-mail address. This indicates that internet is predominantly accessed from work or cyber cafés. Computer penetration remains dismally low across the continent. Even in the economic powerhouse of the continent, South Africa, only 12% of households have a working computer at home. This was followed by Botswana at 6.5%, Namibia at 4.5% and Cameroon at just below 4%. Tanzania showed the lowest household PC penetration, at less than 1%, followed by Uganda at 1.5% and Rwanda under 2%.

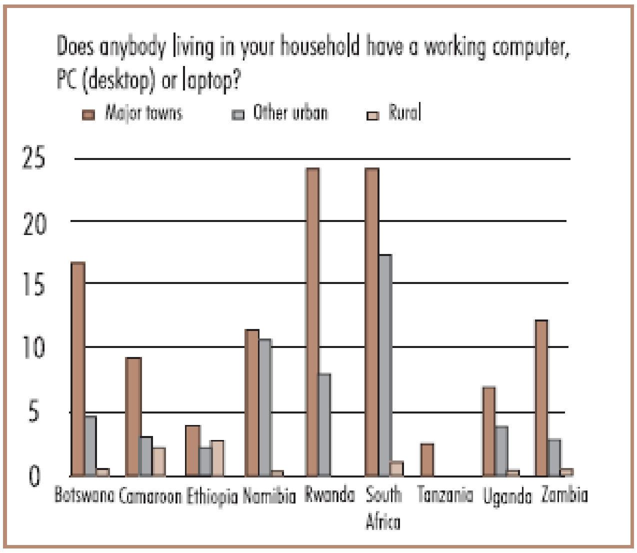


Figure 5-28 Computer penetration in household

Besides this, if one looks at gender breakdowns for rural areas in Botswana and Namibia, of the few who have phones, considerably more men have phones than women, reflecting the predominance of phone ownership by men in less developed economies. The equity of phone distribution would appear to correlate with those countries with increased urbanization, and disparities in access appear greater where services represent a scare resource and access is more limited.

The shortage of the network infrastructure besides, increase even more the prices: bandwidth costs of access to the international internet backbone via VSAT, for example, are almost 30 times the cost in more industrialized countries.

Overall therefore, large numbers of people, around 80% of the population who do not own phones of any kind, remain highly dependent on public access telephones (very sporadic too). Additionally, while there is considerable overlap between those that have fixed phones, mobile phones and internet access, there appears to be a growing number of mobile phone users who have substituted their mobile phones for fixed telephones, largely due to convenience and flexibility, but also in some instances due to high fixed line rentals, usage charges or flawed billing. Of concern is the near absence of internet in many African countries. Outside South Africa, the incidence of home PCs is negligible and the only access is largely through work and internet cafés, though in both cases the access is limited and the findings seem to suggest that it is the same people that have work access that use cyber cafés where they are available. The reasons for this are that people who are not using, or have not used, the internet regard it as unreliable or expensive or both.

It is difficult to make a statistic of the presence of the PLC technology in Africa, which stays for now, limited to few cases: in South Africa, in Ghana and in Egypt.

5.4.2 Regulatory Situation (PLC Networks and Equipment)

[A04] The African telecommunications sector is continuing to show a more liberal policy to attract foreign investment and to improve its infrastructure and services. This trend is witnessed especially in the increased availability of cellular telephones and is reflected in:

- the increase in the number of countries that have established an independent regulatory agency
- the increase in partial/full privatization of the telecommunication operator
- the increase in the number of private ISPs and cell-phone operators

The path taken in the liberalization of the telecommunication sector across the continent is similar:

- separation of the Posts and Telecommunications sectors

- separation of the telecommunications regulating and operating agencies
- licensing of operators of various types of telecommunications services
- partial/full privatization of the PTO

By the end of the year 2000, 25 countries have established an independent telecommunications regulatory authority.

5.4.2.1 ICT Policy

[A04] The African Information Society Initiative (AISI) calls for the elaboration and implementation of national information and communication infrastructure plans in all African countries. Past years saw continued effort in preparing National Information and Communication Infrastructure (NICI) plans and policies across the continent. The figure below shows the status of the development of NICI plans and policies at the end of 2000. Thirteen countries have NICI policies and plans while ten countries are in the process of designing NICI policies and plans.

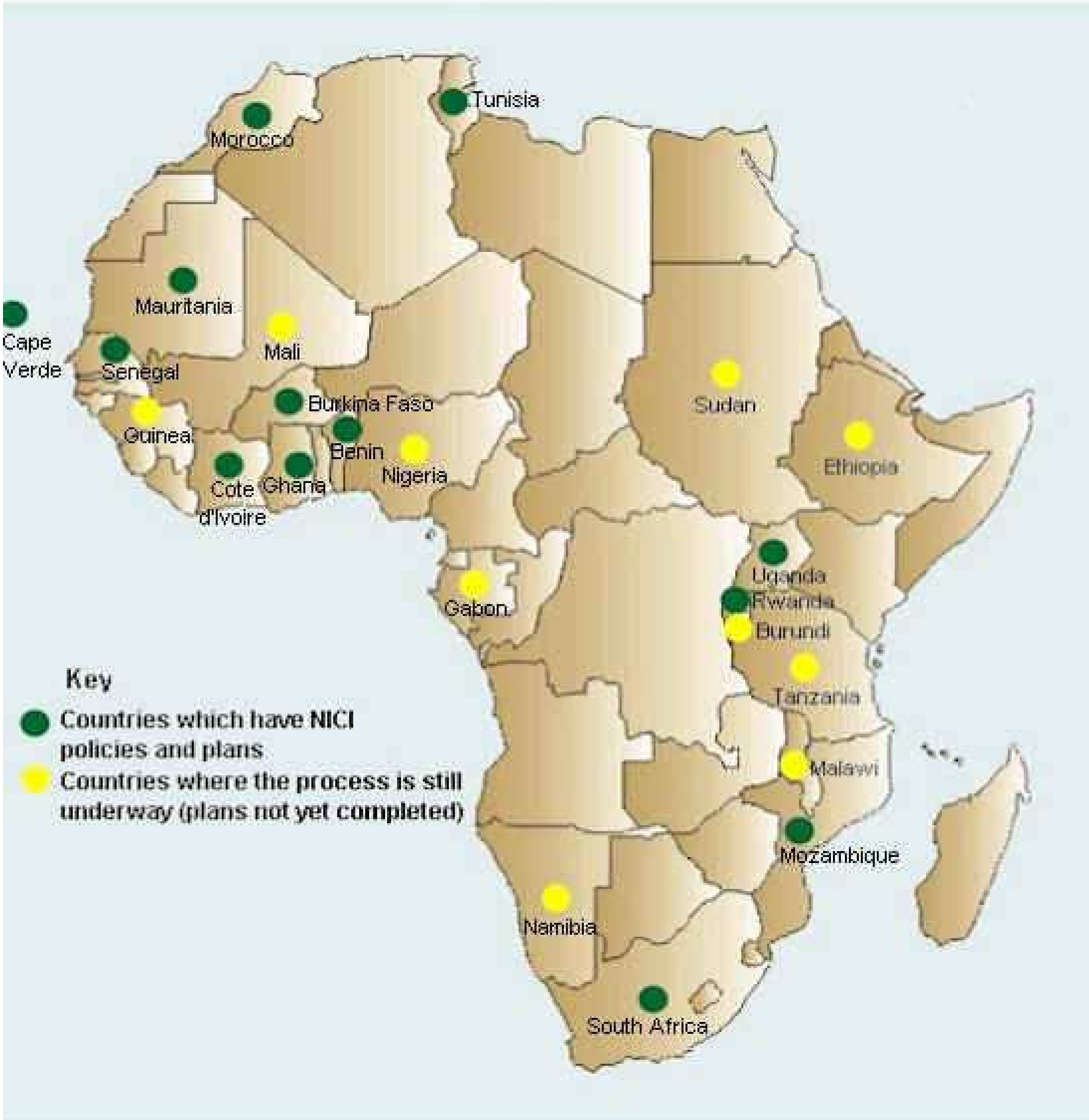


Figure 5-29 Status of NICI Policies and Plans

5.4.2.2 African Telecommunications Regulatory Agencies

The African countries developed (and they are still developing) both technology and regulatory, in different times and mode. In many African nations, the Ministry of Post is also the Ministry of Telecommunications, although the tendency to divide the two areas is growing.

In Appendix B they are related, for every African state, the responsible ministry of the telecommunications, the telecommunication regulator and the telecommunication operator.

5.4.2.3 The regulation of PLC in South Africa

5.4.2.3.1 Overview

South Africa is the African country with the first and more meaningful PLC activity (in Tshwane, City Power Jhb). For this reason, the PLC Workgroup for Policy and Regulations has been established since 15th August 2002. The work group works closely with industry stakeholders and international organizations, such as European Telecommunications Standards Institute (ETSI). The work group has also the permission to test and develop technical specifications on the available equipment in their laboratory.

[A05] The Regulatory Landscape that PLC has to be traversed over is shown in the diagram below.

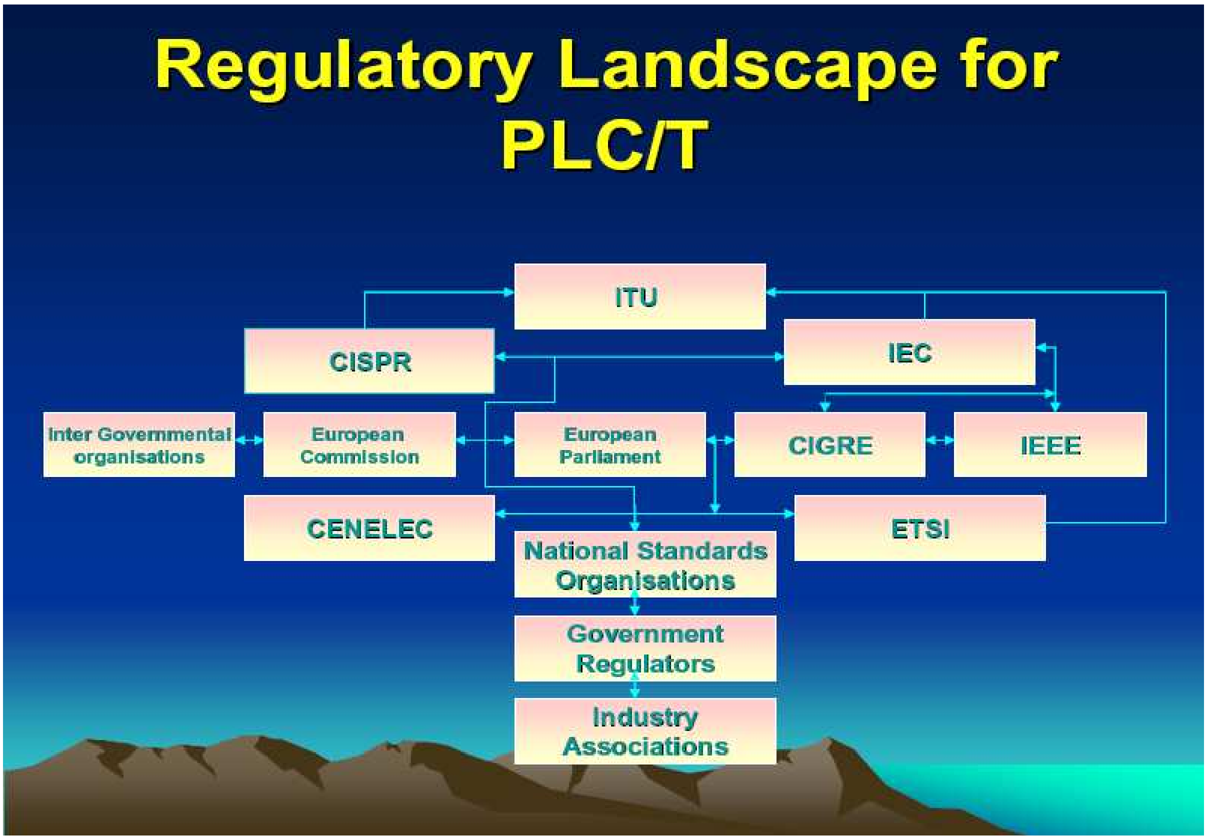


Figure 5-30 Regulatory Landscape for PLC/T

The EDI (Electricity Distribution Industry) Restructuring Programme changes the ownership and control of the Low Voltage (LV) network. Metros and Municipalities may not own the network but according to the Restructuring Programme, they will be shareholders in the RED (REDs are companies into which both municipalities and Eskom will transfer their electricity distribution business: Municipality remains service authority and RED becomes service provider). This would imply that they have a say in the network in their area. In the same way decisions had to be taken on telecommunications networks, equipment, and radio channels licensed to metros and municipalities. To this end the EDI Holdings Wires Committee issued a position paper outlining the pertinent telecommunications issues and how they should be dealt with. Issues were identified and solutions recommended, followed by a discussion on scope and deliverables, advantages/disadvantages, risks, roles and responsibilities, critical success factors, timing and costs. In summary the paper outlines the following position:

Asset Demarcation

Recommended Position:

1. ESKOM: All telecoms assets and staff ring-fenced within Eskom's Enterprises Division remains with Eskom Holdings. All telecoms assets ring-fenced within Eskom Distribution Division will be transferred to the REDs.
2. Metros/Municipalities: Only those assets and staff that serve the electricity department exclusively will be transferred to the REDs. Telecoms assets and staff that serve non electricity functions such as water, waste, traffic control or emergency services will remain with the Metros/Municipalities.

License Demarcation

Recommended position:

1. Eskom Holdings remains the owner of its current radio frequencies. The Metros and Municipalities retain ownership of the licenses of those frequencies that are also used for any non electricity functions. In both cases ICASA (Independent Communications Authority) is requested to extend these licenses to the REDs thereby granting dual frequency ownership. Where radio frequencies are used exclusively by an electricity department of a Metro or Municipality, the relevant licenses are transferred to the REDs, as in the case of the telecoms assets.

Telecoms Services Model

Recommended position:

1. Eskom Holdings and the Metros with PTN licenses need to inform ICASA that their PTNs want to sell spare capacity to the REDs. They then request approval from ICASA and obtain the necessary license extensions required.

2. ICASA is requested to grant permission to the Metros and Municipalities to continue providing services to their former electricity departments in the RED after RED establishment.
3. A multi party telecoms service provision model is preferred, whereby any division in the RED would be able to obtain telecoms services from any legal telecoms service provider, even if such a provider is not its former owner.
4. SLAs (Service Level Agreement) and tariffs should be negotiated to ensure cost based / market related tariffs and adequate quality of service.
5. Eskom Enterprises and the Metros/Municipalities should be offered the first opportunity to investigate and quote the REDs for projects to provide new telecoms services and/or services in currently under-serviced areas to meet the REDs' requirements.

Areas that are under serviced generally fall in the boundaries of the smaller municipalities (such as Cape Town UniCity, Ekurhuleni Metro, Nelson Mandela Metro, Johannesburg Metro, eThekwini Metro and Tshwane Metro). This offers an opportunity to provide telecommunications services in these areas using PLC technology. As the incumbent telecommunications operator failed to provide in these areas in terms of their license requirement, Government can use this opportunity to make good the promise made to the people.

[A06] On the services side, the Independent Communications Authority of SA (ICASA) has published the long-awaited licence conversion framework, which allows telecommunications and broadcasting providers to broaden the scope of their service offerings. Now, operators can use their networks for whatever services they want to. It means SA's licensing framework no longer has a distinction between fixed and mobile licensed entities. A fixed-line operator like Telkom may enter into the mobile market, while a mobile operator like MTN may choose to extend its services into the fixed-line market if it chooses to. Additionally, there are no limitations as to what services telecoms operators may provide using their network. Licensees can provide telecoms or broadcasting services, and they can choose to bundle their services or not, depending on their business model. The only key distinction under the new framework is between individual and class licences, where the latter has a limited geographic scope. As previously, applications are subject to spectrum allocation.

Value-added network service (VANS) providers now have an option of applying for an individual licence, which would give them the same rights and privileges enjoyed by the big fixed-line and mobile telecoms operators. VANS will only need class licences to build their own networks and sell spare capacity. Depending on how many VANS take advantage of the opportunity to build their own networks, and how much capacity they spare, the new licensing framework could bring about options for VANS for national, regional and metropolitan bandwidth.

The dissolution of Telkom's fixed line monopoly, will create new service providers, such as SNO, licensed in December 2005 and officially launched as Neotel in August 2006.

[A06] The Icasa Act amendments and the EC Act redefine and expand the powers of Icasa to control the communications market. Icasa's key functions include regulating players in the communications sector, issuing operating licences to service providers, managing the frequency spectrum in South Africa and protecting consumers against unfair business practices. Most significantly, Icasa has now been given power to dictate price controls, terms and conditions of access, interconnection and facilities leasing.

The mobile services market, with a CAGR of 9%, is forecast to grow faster than the fixed line and fixed wireless market which has a CAGR of 5%. In the mobile services market, voice remains bread and butter of the mobile market but mobile data services will be the industry's growth powerhouse over the forecast period, which has a CAGR of 29% driven by multimedia content and data access for PCs and laptops.

5.4.2.3.2 The situation of the fiber optics

[A07] Before markets were liberalised, telephone companies were in the main government-owned institutions. When they wanted to build undersea cables, governments financed this activity and the project was carried out by the government-owned telephone company. Liberalisation has opened the market to new competitors at both an international and national level. However competition in the building of new international fibre routes has been slower to arrive. International fibre routes are in effect a form of shared infrastructure and often shared between potential competitors. To build them requires considerable capital sums and there has to be ways of managing the risk. Unusually the risk is long-term and spread over the life of the cable, usually 25 years. Their subsequent management requires a clear framework for co-operation between participants. Because of Africa's political and market risk, most projects of this sort combine public and private finance.

For Example, the SAT-3 submarine communications cable (which runs from Europe down Africa's west coast) was monopolised, until June 2007, by a consortium of state-owned and private telecommunications providers in different countries, whose pricing structures have been the subject of criticism. Then, the Association of African Universities has called for African leaders to use the end of a monopoly on a submarine communications cable to provide cheaper Internet access for students (such as the university students of Ghana).

Additionaly, on 19 June 2007, parliament's portfolio committee on communications approved the Nepad/Eassy protocol to build undersea and terrestrial links on Africa's eastern side. Countries that have signed the protocol are SA, Rwanda, Lesotho, Zimbabwe, Zambia, Namibia, Democratic Republic of the Congo, Madagascar, Mauritius, Uganda and Tanzania.

5.4.3 Technical Network Configuration and Equipment Supplier

In Africa there are relatively few projects concerning the use of PLC. Those that are there however, see the share of some among the most important PLC equipment producers: DS2, Ascom, Inovatech, Mitsubishi Electric, PLC International and Corinex.

5.4.3.1 DS2

[A39] Founded in 1998, Design of Systems on Silicon S.A. (DS2), is the leading supplier of silicon and software for Power line Communications and the first company to develop and market PLC chipsets delivering data rates of up to 200 Mbps. The company currently employs over 100 highly qualified graduates and continues to invest in the innovation and design of chips and in the development of strategic partnerships with manufacturers to accelerate the implantation of this technology in both the PLC access and consumer electronic markets. Universal Powerline Association (UPA) and the European Commission funded OPERA consortium have adopted DS2 technology in support of multi-vendor standard certified product. DS2-based products enable triple-play services (video, voice and data) over the same electrical network.

In Africa, DS2 has worked in the construction of a PLC network in Pretoria (South Africa), Ghana and Uganda.

5.4.3.2 Ascom

[A40] Ascom is an international solution provider with comprehensive technological know-how in Mission-Critical Communication. The company concentrates on the core areas of Wireless Solutions and Security Solutions. The company has subsidiaries in 17 countries and a workforce of some 2,100 employees worldwide.

The Swiss company has supplied powerline equipment for the big project of Tshwane (South Africa) and Johannesburg.

5.4.3.3 InovaTech

[A15] InovaTech is a global group of companies with extensive experience in high and low speed powerline communications technologies. InovaTech staff have expertise in design, installing, and operating telecommunications networks using existing electricity distribution infrastructures having worked on more than 40 projects in 20 countries across every continent. InovaTech was the second organization to be granted a development license by DS2, the global leader in access powerline communications. InovaTech's product range includes all elements required to build telecommunications networks including Customer Premises Equipment, Head Ends, Repeaters, Medium Voltage Transition Nodes, and low cost high performance PLC adaptors used for distributing broadband data services over domestic electricity wiring.

InovaTech operates through 4 regional divisions covering Asia Pacific, EMEA, Americas and CIS. InovaTech EMEA is the division based in London, responsible for delivering products, services and building service in partnership with local ventures in Europe, the Mediterranean, the Middle East and Africa.

InovaTech has installed powerline communications equipment at sites in England, Northern Ireland, and South Africa (Tshwane) delivering broadband internet access, security services, video and telecommunications services to houses and commercial buildings.

InovaTech has helped the city of Tshwane to implement broadband. The City of Tshwane Metropolitan Municipality (CTMM) was established on 5 December 2000 when various municipalities and councils that had previously served the greater Pretoria and surrounding areas were integrated. The CTMM covers an extensive municipal area (3,200 km^2), stretching for almost 60 km east/west and 70 km north/south. The municipal area includes Pretoria, Centurion, Akasia, Soshanguve, Mabopane, Atteridgeville, Ga-Rankuwa, Winterveld, Hammanskraal, Temba, Pienaarsrivier, Crocodile River and Mamelodi. The area is inhabited by approximately 2.2 million people.

The power distribution network owned and operated by the council in the Tshwane test area was particularly challenging as it was a very high electrical noise environment. The noise was caused by equipment in the council facilities and other unidentified sources in the grid. Several other vendors had attempted to demonstrate broadband service delivery over PLC but had failed because of the high noise floor.

A team of InovaTech engineers undertook the design and installation on behalf of InovaTech's South African distribution partner. InovaTech successfully demonstrated sustained high speed broadband delivery to offices at distances up to 400 metres from the head end using then state-of-the-art DS2 based equipment capable of delivering up to 45Mbps aggregate capacity.

5.4.3.4 Mitsubishi Electric

Mitsubishi Electric Corporation is a division of the Japanese colossus Mitsubishi, based in the Tokyo Building (in Tokyo). The firm, established on 1921, manufactures electric and architectural equipment, as well as a major worldwide producer of photovoltaic panels.

Mitsubishi Electric launched the first compact PLC on the European market 25 years ago. The firm is always distinguished for the great push toward the research and the innovation. In Africa, Mitsubishi Electric is present in Egypt and South Africa.
The technology currently being tested in Johannesburg was supplied by Japan's Mitsubishi Electric.

5.4.3.5 Corinex

[A42] Founded in 1989, privately held by a group of investors, Corinex Communications Corp. is the leading manufacturer of networking products which enable the transmission of all forms of digital data over a premise's already-existing cable infrastructure (electrical and coaxial cables) and via wireless connections.
Corinex has developed new comprehensive PLC access solution offering significantly lower cost of product, installation and maintenance.
The Canadian firm is a Board Member of Universal Powerline Association (UPA), a founding member of Home Gateway Initiative and of IEEE 1901 Powerline standards working group and a member of the HomePlug Powerline Alliance.
With PLC International, Corinex Communications has won the bid for a powerline based smart village in Cairo.

5.4.3.6 Others equipment suppliers

Others PLC equipments suppliers are: PLC International, SMC and D-Link.

PLC International is a group of enterprises located in Chile, Venezuela and United States of America. The company deals with the automation of electrical systems, AMR, electrical protection and control. PLC International manufactures PLC products in Venezuela, Egypt, China, Brazil, Chile and many others countries. With Corinex, PLC International has won the bid for a powerline based smart village in Cairo.

SMC (www.smc.com) is a seller of PLC-based products, both of 200Mbps and 14Mbps. It operates in Algeria, Egypt, Morocco, South Africa and Tunisie.

D-Link (www.dlink-me.com) is a note firm that produces chiefly modem. It is also interested, even though in smaller way, to the PLC technology too. In Africa, D-Link sells in Algeria, Egypt, Libya, Morocco, Tunisie, South Africa, Zimbabwe, Botswana, Namibia, Zambia, Cameroon, Ghana, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Nigeria, Tanzania and Uganda.

5.4.4 PLC service providers and cases

5.4.4.1 Overview

[A28] Africa Online is one of the few pioneering service providers providing broadband Internet access over power lines. Access speeds are available from as low as 32Kbps to as high as 1Mbps, and more. Tests have been carried out in Ghana and they are exploring providing this as a commercial service shortly.
Africa Online provides also to their clients, the classical ADSL access, the DVB (Digital Video Broadcast) downlink-only satellite technology, the VSAT (Very Small Aperture Terminal) 2-way satellite service, the VPN (Virtual Private Networks) security solution, the MPLS (Multi-Protocol Label Switching) standards-approved technology, broadband wireless (both mobile and fixed solutions), VoIP, ISDN and Dial-up connectivity.

[A29] At the end of 2003, Grintek Telecom signed a partnership agreement with Cybercom International to distribute its latest Power Line Communications (PLC) solution into Africa. The agreement covered sales, implementation, support and training. The architecture, at this time, offered a bandwidth of 45 Mbps. The Tshwane Municipality purchased the InovaTech DS2 solution as a pilot system as part of its ongoing investigation into new technologies. Allied Technologies Limited (Altech), was a joint winner of their Top ICT Companies in SA research survey. The other joint winner was Hewlett-Packard. Additionally, the City of Cape Town implemented Landis+Gyr's latest technology common-base prepayment electricity meters, the Cashpower Sabre model. The City of Cape Town required a specific range of serial numbers for the meters that was compatible with its database system.

For many countries that are interested to the PLC technology, there is also some country that has yet no appreciation of the commercial potentials of power lines communications, as is the case with Nigeria's power utility company NEPA.

[A30] In Nigeria, not much has happened on the discussions between internet service companies such as Direct-on-PC and NEPA to use NITEL's power line infrastructures to deliver internet services.

5.4.4.2 PLC cases in Africa

Despite the electric grid is poorly spread in Africa and reaches only the 2% of the population, there are some interesting projects related to the use of power line communications, many of which in an already advanced state. The most important projects are in South Africa, Ghana and Egypt.

5.4.4.2.1 PLC cases in South Africa

[A15] Tshwane is widely considered the leader when it comes to municipal telecoms, and when one looks at their infrastructure and projects it is not difficult to see why. This municipality has developed an extensive fiber infrastructure and is now starting to build telecoms services on this foundation.

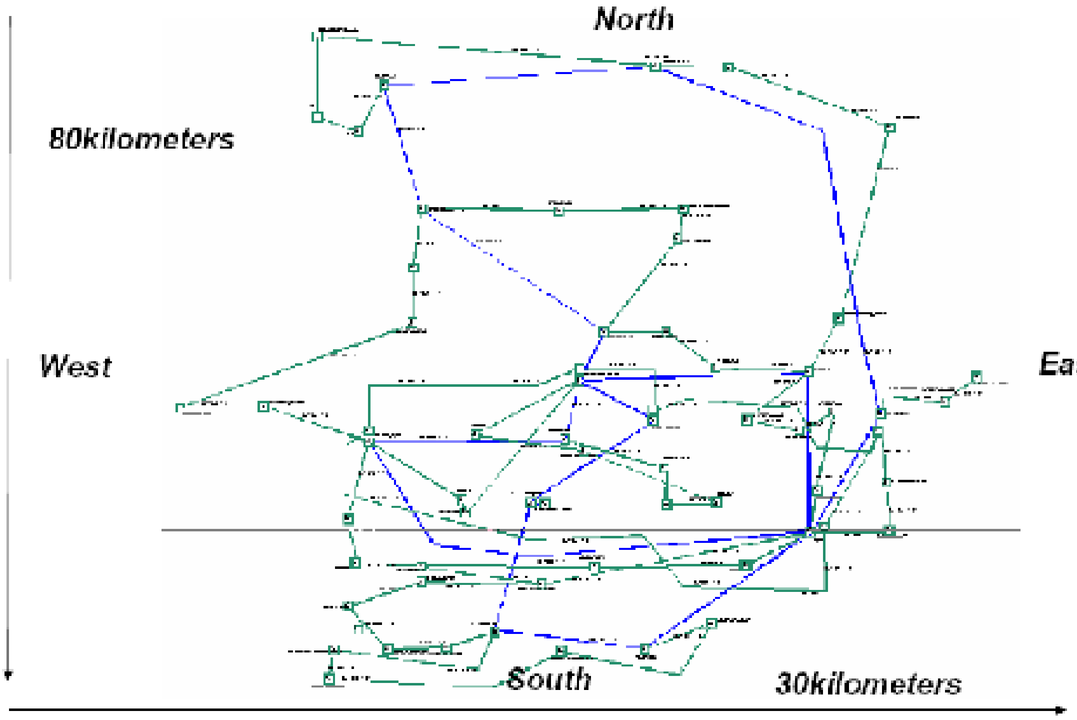


Figure 5-31 SDH fibre transport network in Tshwane

One of the most exciting developments is the Rooiwal Broadband Village project where all the houses in this town have been furnished with a 4 Mbps broadband connection. These connections are 4 times faster than Telkom's fastest DSL offering, and make use of Broadband over Power Line (BPL) technology.

The traffic is carried over 28 km of Tshwane's fiber network while the last mile connectivity is provided through the existing power cabling. The full BPL network has a theoretical capacity of up to 200 Mbps.

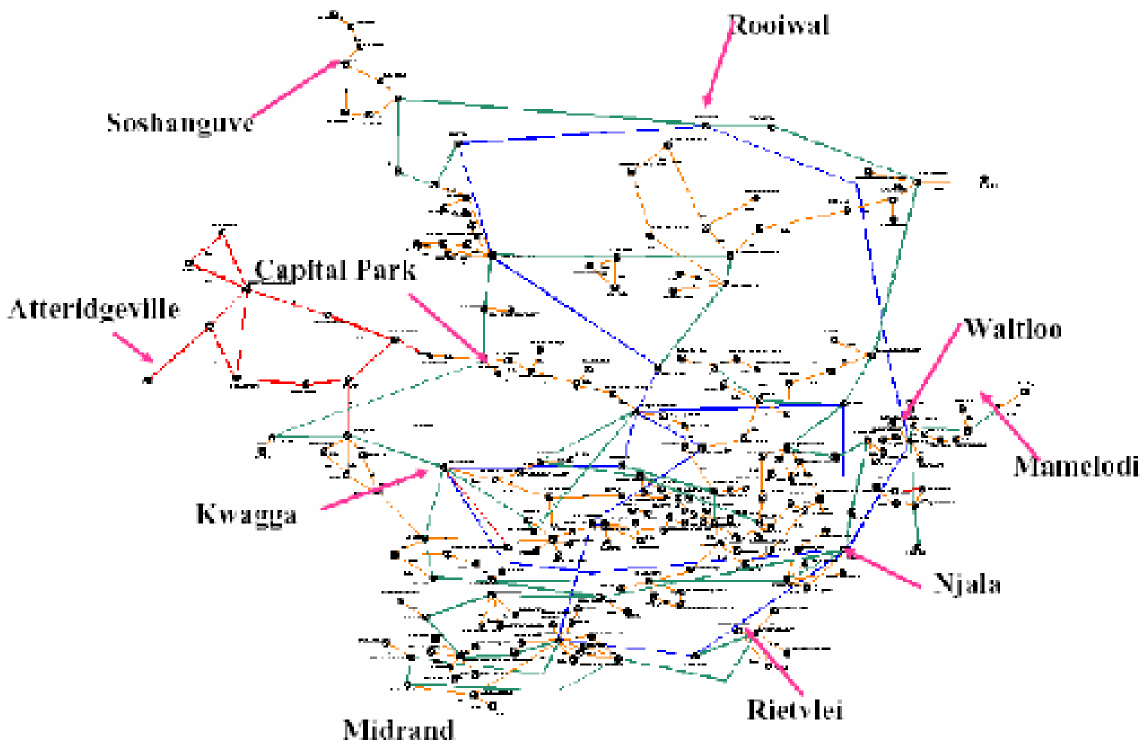


Figure 5-32 Electricity IP network in Tshwane

Charles Kuun, Manager of the Tshwane Digital Hub, says that the project is a great success. He pointed out that users utilize these fast broadband connections for anything from research to entertainment.

The Tshwane Metropolitan Area Network (MAN) is however not only sticking to fixed networks, and based its developments on wireline, wireless and powerline (PLC, BPL) communications.

Tshwane aims to establish integrated broadband networks creating an effective broadband cloud over the city. They further plan to provide free Internet points and would like every citizen to have an e-mail address and a means to access their mail.

This may seem like a very ambitious aim, but Tshwane is working with various interested parties to ensure its success. With their extensive fiber network and the innovative use of existing technologies it is not far fetched at all.

The possibility to offer telecommunications by deploying broadband over power line (BPL) required some changes in South Africa's current regulatory framework. Now it is legal, in terms of new regulations introduced by the minister, that each municipality has metro telecommunications licenses to provide broadband data communication to the surrounding community across its power grid.

South Africa is trying also to develop telecommunications competition by establishing a second network operator (SNO) to compete nationwide with incumbent Telekom. The SNO is partially owned by power utility giant Eskom and transportation conglomerate Transnet.
From the point of view of the consumers, the result of a partnership between the City of Tshwane (CTMM) and Goal Technology Solutions (GTS) is the offer of an uncapped 3 – 10 Mbps Broadband for around R 300 (30 Euro) per month. BPL technology, with a theoretical throughput of 200 Mbps, will be used as a last mile access technology while Tshwane's well established fiber network will serve as the backhaul network.
[A17] Kuun, the driver behind this world class municipal broadband network development, is very optimistic about the prospects of this offering. He informed that their BPL trial in the Rooiwal community in the North of Tshwane has been a great success, and a commercial trial was therefore the logical next step.
The Rooiwal trial not only brought Internet and telephony services to users, but was also used for other services like electricity metering and IP cameras. Users in this community enjoy fast Internet access, typically 4 Mbps, used for purposes ranging from gaming to online education.
The new commercial municipal BPL service in the East will be far superior to any other commercial broadband service available today. Vodacom and MTN's HSDPA service can deliver maximum speeds of up to 1.8 Mbps while Telkom's superior ADSL offering has a maximum speed of 1 Mbps.
This project has proven to be so successful that after Tshwane, there has been also the commercial launch in the East Pretoria, where, in November 2005, 130 houses have been served.

[A16] With the new regulations, South African electricity companies plan to launch a phone service to rival state-controlled Telkom that could get landline access to almost all SA's poor at a third of current prices. The new service would deliver voice and data via existing electricity lines and local companies hope to launch the technology in the Johannesburg and Pretoria area. "This could be a major leap in providing underserviced areas in (poor) communities with telecoms at an excellent rate," Teddy Naidoo (Telecoms Manager City Power Johannesburg) told. Although pay-as-you-go mobile phones are common even among the poorest South Africans, only one in 10 people have a landline due to the high prices charged by the fixed-line monopoly, and poor infrastructure. Cheaper phone and Internet access would help slim the economic divide and slash the cost of doing business in South Africa, encouraging foreign investors. Electricity firms say many more people in rural areas and townships would be able to get their first landline if they could access voice and data via power lines, which connect about 98 percent of households. City Power hopes that other regions will quickly follow Johannesburg and Pretoria, meaning they could eventually band together to offer a national network without relying on Telkom for long-distance calls.
City Power reckons 150,000 customers in Johannesburg and 300,000 in Pretoria (around half of its current customer base) will either switch their phone line from Telkom or get a land line for the first time using the new service. Initial estimates showed power companies could offer calls at roughly a third of Telkom's current tariffs, Naidoo said.

[A15] City Power has also a very ambitious project regarding the city of Johannesburg: it consists in the largest municipal broadband roll-out, covering 1,600 m^2.
About 180 private sector company representatives (from telecoms and IT firms big and small) filed into a high-level compulsory industry briefing in Riviera, Johannesburg. Nobody dared to be absent for the briefing. It is simply too huge an opportunity to miss: the contract for a 1,644 km^2 broadband coverage solution.
Officially named “The city of Johannesburg Broadband Network Project”, the initiative involves the city partnering with one service provider, which must provide high-speed Internet to Johannesburg's official population of over three million citizens.

The service should offer anyone in Johannesburg access to the World Wide Web, VOIP telephony, television and radio over IP, video-on-demand, e-government services, free Internet zones and virtual private networks. The network will cater also for the city's surveillance needs, help with traffic management, provide the backbone for commercial display systems, assist local government mobile workers, and bring the city in line with 2010's technology requirements.

The city is not prescriptive about what technology is to be used by the successful bidder. "It could be Wi-Fi, Wi-MAX, fibre or powerline broadband," Zimu (the vice-president of the operations group at City Power) told, adding: "but it must be true broadband - we're talking about speeds of over 2Mbps". "It has to be future-proof and scalable. We don't want to have to forklift the solution after five years", he emphasised. "It would be good to see a series of experiments running in the city - it is the duty of government to experiment with different (broadband) technologies". Terblanche (manager consulting) is of the opinion that different technologies may well be used in tandem: powerline broadband has the advantage of being able to run over existing city-owned infrastructure; however, wireless solutions have flexibility in terms of access. The user could be literally anywhere in Joburg and its surrounds and connect. Zimu agrees this scenario of complementary methods is possible, saying that wireline, powerline and wireless all "seek to meet and fulfil the same need for broadband connectivity". "With powerline broadband, don't forget that you can have nomadic connectivity. You can plug in and access the Internet from wherever", he says.
In this context, the powerline communications seem to have good possibilities of employment (at least in conjunction with other technologies) in a great and modern city as Johannesburg. To appraise this possibility, a Broadband over Power Lines (BPL) has been launched in the Alexandria Township North of Johannesburg, involving 183 households.

All these projects and investments, are contributing also to the birth of new telecoms operators that should integrate themselves in the coverage of the territory or to increase the competition inside the market, in advantage of the end users: one of these operators is, for example, PowerNet Telecommunications, which intends to supply last mile telecoms services in areas that are beyond Telkom's ADSL service coverage.

5.4.4.2.2 PLC cases in Ghana

In comparison to South Africa, Ghana has a less advanced network structure and also less economic resources. Nevertheless also here, interest in powerline communication is strong. The electric grid of Ghana is sufficiently expanded and however, it is more extended than that telephonic network. From here the interest, very strong, in the PLC technology, more than for the wireless one, still too much expensive.

Tests are still to the initial stadium, directs above all to show that the powerline communication is also possible and feasible in Ghana.

[A18] Africa's first powerline implementation took a step nearer with a demonstration given in Ghana to a number of key players, including the Electricity Corporation of Ghana. Although there are now a number of implementations in the developed world, it remains a technology that has to prove itself.

Cactel Communications (formerly Intell Solutions) demonstrated a small-scale installation and has plans for a much larger pilot.

In broad terms, there are two types of powerline solutions: one uses medium sub-station technology (33kv) and the other low-voltage sub-stations (11kv). In terms of a capital city like Accra, it has about 29 medium-voltage sub-stations and around 100 low-voltage sub-stations. Cactel's Boye claims that the technology solution offered by its partners for deployment in medium-voltage sub-stations is 70% cheaper than anything offered for deployment in low-voltage sub-stations.

Deployment is carried out by switching off the sub-station and attaching an auxiliary cable from a coupling unit to a high-speed modem. This allows the bandwidth signal to pass through the same cable as the power it also carries. A medium-voltage sub-station has a 3 kilometre range but this can be extended by deploying what is called a Home Gateway which includes a modem and repeater to boost the signal strength.

In the test demonstration a medium-voltage sub-station was connected to the premises of the Graphic Corporation (publishers of the Daily Graphic) which has its own low-voltage sub-station. The test took place on the third floor of the building and powered up all the sockets as POPs. "It was a test designed to show that the system can work in an African environment".

Cactel says it was able to demonstrate internet connectivity, internet PC telephone, live streaming and the use of a surveillance camera. Boye told: "We were able to use Skype to make calls to Europe and to make PC calls to Ghana Telecom and mobile subscribers on all networks in Ghana. We achieved low latency. We were also able to show video surveillance from a camera installed in a different part of the Graphic's premises".

The bandwidth was supplied by Africa Online using a 2 Mbps link via a wireless link to the roof of the graphic building. According to Boye: "Speeds are dictated by the weakest link in the chain. Therefore in this instance the speeds achieved were limited by the link provided by the ISP. But the a medium to low-voltage link could give you as much as a 9 mbps speed. A chip capable of delivering 45 mbps can be used at this layer and a new one is being built that could give 200 Mbps".

However in the not too distant future it will show the Ghana's power company a Remote Energy Management System. This is able to: read customers' meters automatically; identify where power lines have gone down and where power is being drawn down illegally. On average one medium-voltage sub-station serves 10 low-voltage transformers which gives a potential customer base of approximately 2,000 customers. A medium-voltage sub-station modem costs between USD 5-6000. The chip is produced by DS2, one of Cactel's technology partners.

If distances are greater than 3 km, then there is a need a Home Gateway (a modem and repeater) which costs USD 3,000. If you needed to reach 2,000 customers you might need two which would cost USD 6,000. Each power point used needs an ICPE which can take up to three devices and these cost USD 100 per power point.

Boye foresees the power company being bale to create its own supply ring: "You can ring together 10 medium-voltage sub-stations. It is the ubiquity that this approach will offer that makes powerline the key to last-mile solutions. It can also be used in a rural environment where the only requirement is access to electricity".

According to Boye 90% of the population in urban areas is passed by power supply lines and this falls to 50% in rural areas. As he points out: "All regional districts and their capitals are covered.

Cactel Communications has received encouraging signals from the regulator, the NCA and we believe that the Government is keen to see the company offer a larger pilot in rural areas.

5.4.4.2.3 PLC cases in Egypt

Egypt has good resources, both economic and infrastructural, that have allowed it to jump a long phase of tests concerning the powerrline technology, and to focus itself on the pratcical realization of a village interconnected with PLC technology.

[A19] On 27th June 2007, PLC International and Corinex Communications have won the bid for a powerline based smart village in Cairo, Egypt. The Ministry of Communications and Information Technology (MCIT) chose PLC International Inc. integrating Corinex equipment after two RFP processes and extensive technology evaluation.

Phase one of the project comprises three buildings interconnected over the medium voltage power lines. Selected users will receive Voice over Internet protocol (VoIP), video and Internet services.

"We're looking to build a Smart Village, and the technology requirements outlined in the RFP were very strict and demanding", said Eng Samy, MCIT's Under-Secretary.

PLC International and AEDCO (PLC representative in Egypt) have been selected by MCIT: the first one, has years of experience in the high voltage powerline carrier industry and has chosen to team up with Corinex Communications to ensure a complete solution for MV and LV powerlines. The second one says to see a great potential, not just for the triple play, but for automatic meter reading (AMR), MV automation, reclosers control, etc.

5.4.4.2.4 Others PLC cases

Goal Technology Solutions (known as GTS) has rolled out operational 30 Mbps connections in South Africa and is currently deploying in Uganda for UTL. At the end of 2006 it has tested IP-TV, based on DS2 technology.

[A17] It has run voice and Internet, installed high-quality security cameras and deployed water meter reading devices. It has two further roll-outs under way: one in Durban and the other in Uganda. Durban Municipality has given GTS two “real-world” pilots: a school and two houses on a street some distance the mini sub-station. The Uganda deployment for a number of UTL office buildings in Kampala. It is also looking at other African countries including DRC and Rwanda. One of the key problems the technology had to solve was interference from local noise: every time an electric tool or washing machine gets switched on, it generates noise.

The connection to the customer is made using the equivalent of an ADSL modem that delivers a connection of between 6-200 Mbps. The CPE and network for the user costs US$ 280 or US$ 321 with a built-in VoIP codec.

Equipment prices have dropped 35% since the beginning of 2005 and will continue to drop as the technology gains wider acceptance. Meanwhile Cactel Communications in collaboration with the University of Ghana, Legon, has launched a high speed broadband internet, telephony and wireless (Wi-Fi) communications pilot that harnesses the electricity distribution network to provide mile connectivity to the student and staff population at the main University campus, Legon. It has provided 16 users with Powerline Communications (PLC) access to these telecommunication services across three sites on the Legon Campus. The demonstration will run for 3 months. The PLC network which is based on the university’s existing electricity network has linked the International Students Hostel, the ICT Directorate and the Registry with a high-speed broadband network, telephony and multimedia services such as video on demand and remote video surveillance via CCTV. Cactel’s network also demonstrates the interoperability between PLC, fibre and wireless networks. Cactel’s PLC technology is based on the pioneering technology developed by DS2 of Spain, which provides up to 200 Mbps of data transfer along existing electricity infrastructure.

Studies are instead in progress in Tanzania, to know the feasibility of the use of the Powerline technology in the telecommunication system development.

In particular, Tanzania has a teledensity of 1.42 and an electricity coverage of 10%. The electric grid therefore, it is distant from reaching the whole population, nevertheless it is more present than the telephone lines and besides, interest in PLC technology shown by the Tanzania, despite its scarce extension of the electrical grid, show the desire to don't remain a country isolated by the rest of Africa (and of world). Deciding to immediately invest in the Powerline technology, would allow besides, to build the future electric lines with more attention and functionality, according to this technology.

In particular, they are studying the possible topology of the network, which is different from developed countries, because the great distances.

The aim of these studies is to have a pilot project of Powerline communication in Tanzania. They have already identified some areas, like Mwanza, Iringa and Mbeya, where PLC solution could be implemented.

At this moment, Tanzania communicates with industries such as Korea Electro-technology Research Institute (KERI) to see the possibility of taking its results and develop PLC for Tanzania, but it is also looking for other companies and donors to extend the PLC project and make the Powerline communication real in Tanzania.

5.4.5 Cost Comparison with traditional Network Technologies

5.4.5.1 Traditional Network Costs

[A36] Africa is the continent with the lowest diffusion of the Internet in the world. This is attributed primarily to the limited penetration, unreliable connections and high cost of the communications infrastructure usage across the continent. Even in urban centers, where there is a relatively higher concentration of infrastructure, there is relatively low usage of internet services due to high and even what some analysts consider extortionist usage prices. The reasons for the limited network roll-out and high prices has often been attributed to the restrictive policy and regulatory environment and monopoly market structures that persist in many African communications sectors, which usually continue in core market segments following privatization, resulting in low levels of competition. As a result, in Africa, the average cost of internet access can be up to 100 times higher than in developed countries. Nevertheless, there is great variation in cost of services to users and market structures in different African countries.

What is clear from the analysis is that across the very different countries, internet costs in Africa are high and countries with some of the lowest per capita incomes have among the highest costs. Prices also do not relate necessarily to real costs. The average price of dial-up (including telephone rental costs, call costs and ISP costs) for 30 hours is $72.90. The average price of Leased Lines is $1292.96 per month (this is for a 128 kbps outgoing, 64 kbps incoming). For comparison the ITU estimated in 2003 that 30 hours of off-peak dial-up internet access in Europe costs $28/month vs. $54 for Africa. Of the total price to connect to the internet via dial-up, telecommunications make up around 60%.

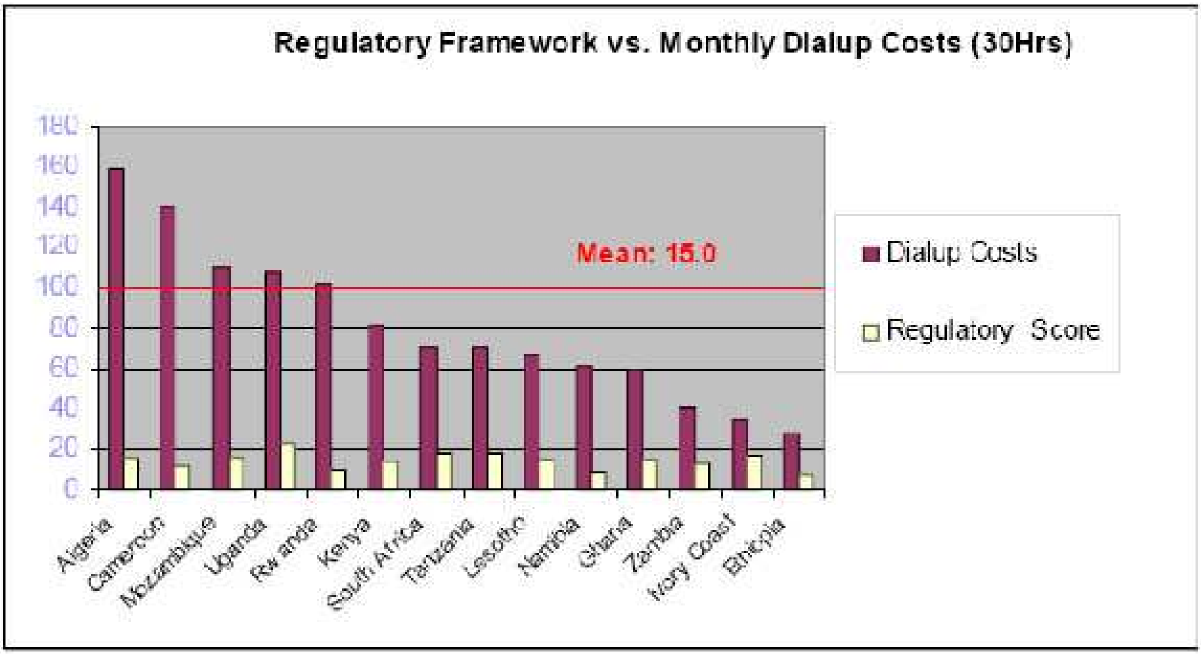


Figure 5-33 Regulatory framework vs. Monthly dialup costs

As shown in the chart above, which plots the regulatory score and the average price of dial-up access, it appears there may be a negative correlation between internet access costs and the country's market openness (there are higher costs in more open markets).

The cost of ISP dial-up services tended to be lower or equal to cyber café charges, with the exception of Algeria, which has the highest ISP dial-up charges and among the lowest cyber café charges.

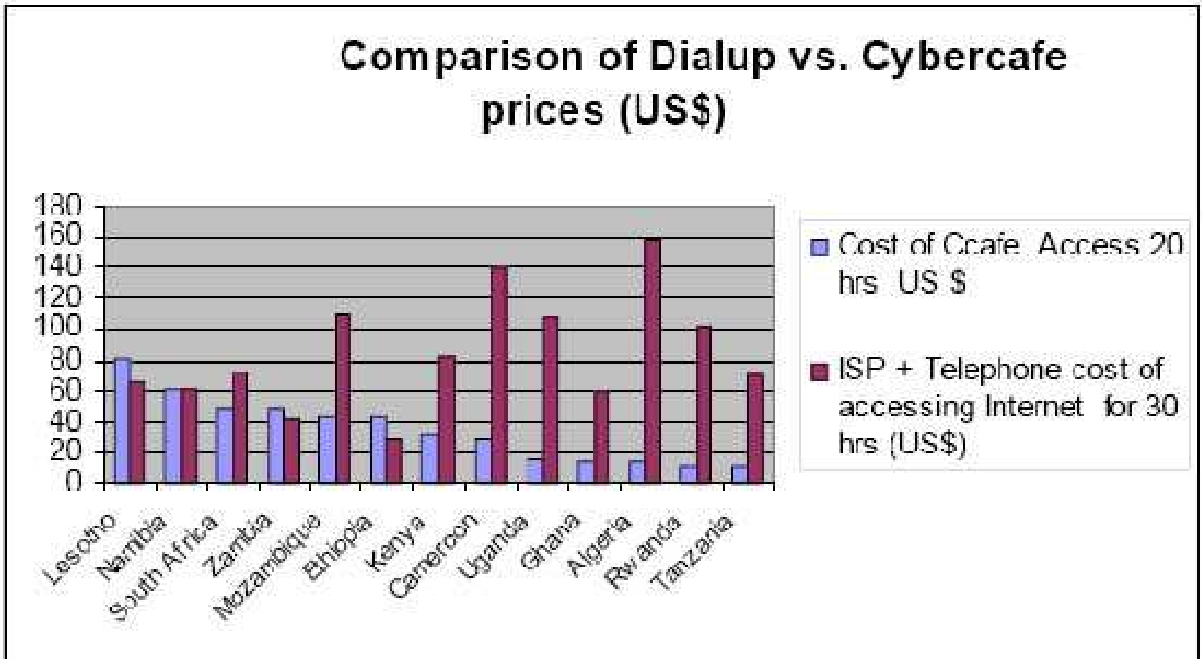


Figure 5-34 Comparison of Dialup vs. Cybercafé prices

Countries with lower user rates tend to have higher ISP dial-up charges and lower cyber café rates. In most parts of Africa, access to the Internet is increasingly being achieved through cyber cafés. The cost of public access can therefore have a dramatic impact on usage patterns. Ghana shows a surprising lack of internet take up, with relatively low cyber café prices at just above US$ 0.50 per hour. This may be attributable to the lack of effective competition despite a duopoly in the fixed line network for some time. Ivory Coast has the highest call charges, followed by South Africa, that is having a declining growth in correspondence with the dramatic increases in local calls from 2002.

The very low competition between ISP, cause the high cost of telecom facilities, that not only has a negative impact at the usage level but also make the cost of a leased line much higher. The cost of leased line bandwidth is cheapest in Kenya, which may account for the significant number of internet hosts. However Uganda has by far the most hosts and relatively low cost bandwidth.

[A37] The very high prices that Africans pay for bandwidth (some of the highest prices in the world), are due in large part to their reliance on satellite transmission (which carries around 80% of Africa's communications traffic) as well as the monopolies that many telecommunications companies enjoy. Fibre optic networks are significantly cheaper than satellites for high-volume traffic. But as of now, only the West coast of Africa has an international cable, the undersea SAT-3. When completed, EASSy will link Eastern Africa to the global submarine cable network by connecting to the SAT-3 cable, as well as cables from Asia and the Middle East.
The system will be capable of carrying 320 Giga bits per second end-to-end, and the cable length is approximately 9,900km. The project cost is estimated to be US$200-million.

[A37] Thus, the EASSy project has been hailed with much fanfare as a way to bring cheap broadband access to a huge swathe of Africa's residents. But the project has been slowed by disputes over the conflicting interests of its member organizations, each of whom is providing funding for and thus gaining access to the cable. The decision-makers include both the member governments and a consortium of parastatal telecoms from the nations of Botswana, South Africa, Mozambique, Madagascar, Malawi, Burundi, Uganda, Rwanda, Djibouti, Ethiopia, Kenya, Tanzania, Zanzibar, Somalia and Sudan, as well as a handful of private telecoms companies from those countries. It also has the support of the World Bank as well as NEPAD. However, as of now, only Lesotho, Madagascar, Malawi, Rwanda, South Africa, Tanzania and Uganda have signed the protocol.

Kenya has been causing the biggest stir in recent months, leading to something of a revolt over the terms of governance of the cable. The Kenyan government has publicly accused

South Africa of trying to dominate the project for its own benefit. It was, after all, South Africa, in conjunction with the World Bank, that created the SPV model. But South Africa's own parastatal telecom, Telkom, told he is considering terminating the investment in EASSy because of concerns about the returns on the company's investment. Telkom and Kenya's complaints are essentially one and the same: both want to maximize profit from the cable and dislike being limited in that regard by a third party.

The failure of SAT-3 in this regard is a case in point. However, they are far from being realized, thanks monopoly structure that controls the access and sets the prices for the cable. Despite the fact that the underlying price for providing the bandwidth amounts to approximately US$2,000 per Mbps per month on SAT-3, countries such as Nigeria and Ghana are charging between US$10,000 and 15,000 per Mbps per month and, until recently, South Africa's Telkom was charging US$25,000. Prices are so high, many consumers have opted to stick with satellite communication. Only now are they starting to come down, thanks in large part to negotiations by ISP associations in various countries.

Nevertheless, for now, the fiber optics is a little diffused and the only way that Africans have to access to contents out of their continent is the satellite.

[A38] Satellite is extremely effective in reaching places where the volume of traffic would not justify a fibre connection. Satellite providers are reluctant to talk about prices (except directly with their customers) because it is often difficult to explain to new customers that the lowest prices are only available to large customers with long contracts. However, if pressed satellite operators will say that below US$1800-2000 per Mbps per month is not likely to be commercially feasible for them. The low level of fibre prices are often quoted in this discussion. These are extremely low because of over-building of capacity and the write-off of initial capital through bankruptcies. On SAT3, prices vary enormously depending on the country involved: they can vary between US$7,000 - US$15,000. The Nigerian ISP Association ISPAN has negotiated a “bulk” deal for its members of US$3,500 per Mbps per month. One SAT3 consortium member has said privately that the cost of the bandwidth to it is US$2,000 a month, and that it will shortly launch an internet bandwidth offer of around US$4,000 a month.

Principal offers that can be found on the African market (in particular in South Africa), are shown in Appendix B.

As it can be seen, the most greater part of the options and the offers, concern the wireless communication, very diffused in Africa (or at least, more diffused than the other technologies). Choosing the same speed, for example 512 Kbps, the various technologies can be better compared.

ADSL	512 Kbps	3 GB	private	€ 50.7	€ 28.5
ADSL	512 Kbps	10 GB	private	€ 50.7	€ 72.0
ADSL	512 Kbps	NO	private	€ 50.7	€ 176.0
Wireless	512 Kbps	4 GB	private	€ 295.3	€ 41.4
Wireless	512 Kbps	9.5 GB	private	€ 295.3	€ 98.4
Wireless	512 Kbps	NO	public	€ 295.3	€ 202.0
Satellite	512 Kbps	NO	public	-	€ 98.4
Fiber	512 Kbps	NO	public	-	€ 295.3

Table 5-19 Comparison access/price among various technologies

As we can see, at equal speed, a satellitaire connection is the most economic solution, followed by the ADSL furnished through copper cables, from the wireless solution and finally from a connection in fiber optics. At this, it needs to add also the costs of installation: the ADSL asks for the smaller costs of activation, while many money may serve to activate a wireless connection, independent from the type of subscription (which discourages the small consumers, increasing even more the discrepancy among connected and not connected). Costs of installation of a satellitaire or fibre connection are not specified (service providers have the tendency to hide them and they often vary a lot, according to the place, both from a nation to an other, and according to the position of the residence). In general, nevertheless, the signature of a satellitaire subscription doesn't involve excessive costs of installation (typically similar to those of an ADSL connection), but it asks for a duration of the contract that can be also of many years. Position of the cables in fiber optics instead, can ask for a very high cost, according to the distance of the residence (typically it should be comparable with that of a wireless installation).

In conclusion therefore, for an irregular consumer, that surf a little bit in internet and that effects few traffic, the most economic solution is the ADSL connection, that however has a limited territorial coverage (few houses in Africa have the fixed line). Instead, for a consumer that doesn't appreciate limitations in the monthly maximum traffic (cap), the most economic solution seems the satellite, that however offers lower speed connection. The wireless solution is suitable instead, for who needs to move himself, is not reached by the ADSL, wants a higher speed of connection in comparison to the satellite, or simply wants to share his own connection with other people. Fiber optics instead, is oriented for now, almost exclusively to the great enterprises that intend to expand their business to the foreign countries (typically out of Africa) and to the communes that want to bring the wide bandwidth in the cyber cafés or in the internet call services.

5.4.5.2 PLC Cost example

As it regards the Power Line Communications instead, the website bplinterference.wikispaces.com brings a gross calculation of a reasonable supply of the PLC service in an African rural area:

Assuming to serve 10 people per mile, and assuming:

- CPE cost: € 356 each
- Repeaters: € 712 each
- Customer Take Rate: 30%
- Backhaul cost: € 712 per month (a T1)
- Repeater distance: 182 meters
- Feed point cost/misc routing equip: € 3561
- Revenue per customer per month: € 28

So:

- Number of repeaters needed: 8
- Number of customers: 3
- Nonrecurring cost: € 10000
- Nonrecurring costs over two years: € 430 per month
- Recurring Cost: € 712 per month
- Revenue: € 85 per month

It concludes that rural PLC is not profitable.

In reality, prices are very inferior to the brought ones: a new 200Mbps CPE, for example the ILV201, produced by Ilevo, costs € 65 (not € 356). At the same time, a repeater costs around € 350 and the repeater distance is around 200 meters. Then, seeing again all the prices to the rebate, the PLC could be convenient for the suppliers.

Corinex, for example, offers a cost effective program for a 200Mbps PLC pilot.

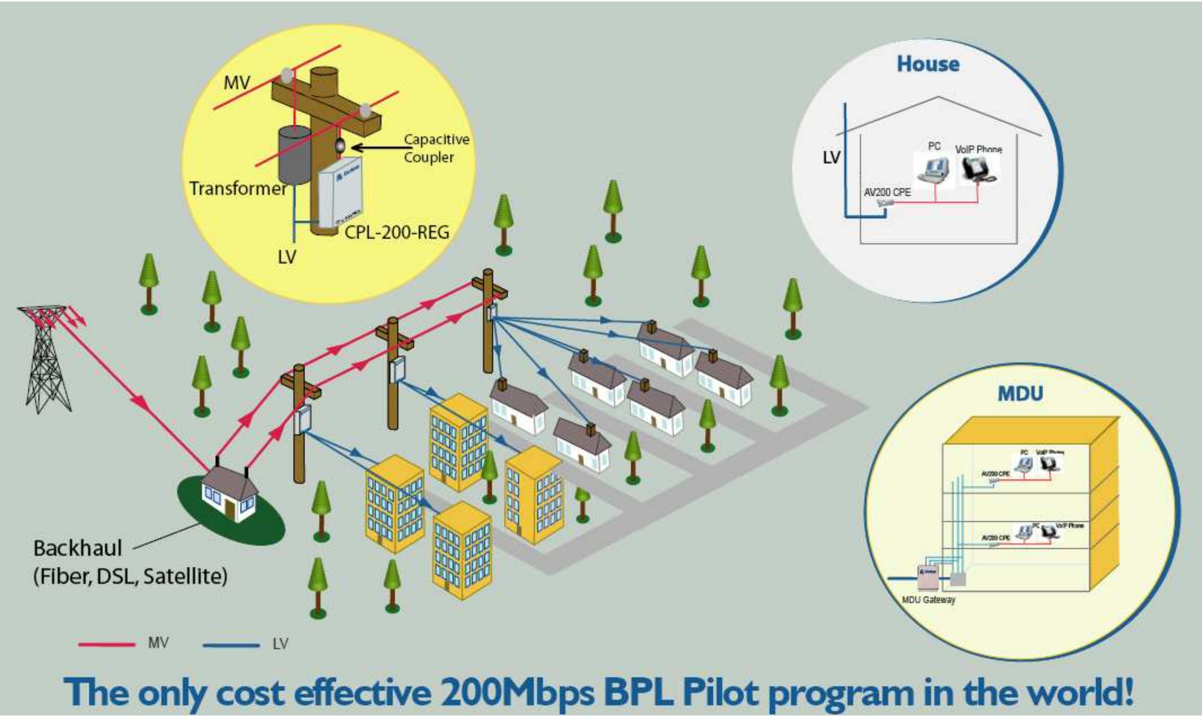


Figure 5-35 Corinex BPL pilot program

In particular the Canadian company has 2 programs: 15 user BAPP, and 30 user BAPP. The first is recommended for utilities that are serious about access PLC. The pilot program allows a utility to deploy a PLC network running in a week. The range is up to 2 line miles, home passed are up to 100 and customers served are up to 15. Corinex sells the solution at $25,000 (€17,810). The 30 user BAPP solution has instead a range up to 10 line miles, up to 500 homes passed, up to 30 customers served and it costs $75,000 (€53,424).
The BAPP-15 pilot program includes 5 PLC regenerators, 10 couplers and 15 CPE. The BAPP-30 solution includes 25 regenerators, 50 couplers, and 30 CPE.

Returning however to the previous comparison, about the prices at the detail, an access to internet based on power line, should have some inferior prices in comparison to those practiced for a connection ADSL. The City of Manassas for example, is provided with connectivity to broadband to all customers. Installations are fast and easy, and the internet access is fast (800 Kbps for G1 equipment and 4 Mbps for G2 equipment) and reliable. Currently they connect a customer to broadband service for just $24.95 per month (€17.70). This can reduce with the increase in customer numbers and the advancement in technology. The costs of installation could be instead of little higher (it depends a lot on the location of the house), but however inferior to those paid for the installation of a wireless connection (hypothesizing always that the house is reached by the electric grid). Nevertheless for the consumer there would be the great advantage to have, at the price of an ADSL, a faster and uncapped connection (very cheaper than an uncapped ADSL).

5.4.6 Barriers and future Opportunities for the PLC Technology

The development of the PLC technology in Africa has ahead a lot of barriers, but also some important opportunities.

5.4.6.1 Barriers

The greatest obstacles for this technology are represented from:

- The redoubt expansion of the electric power grid
- The thefts of cables voters or the voluntary damage of the electric infrastructures
- The very great distances
- The rationing of the electricity and the not homogeneity of its distribution
- The very low average income of the most part of Africans
- There are very few computers
- The points of strength of the other technologies

<u>The redoubt expansion of the electric power grid</u>

In Africa, access to modern energy services remains very low. Less than 20% of Africa's population has access to electricity (2% in the rural areas). The gap between urban centers and rural areas is then, very great. Few africans that live in outskirts have electricity: under these conditions it is unthinkable to be able to furnish a power line based service. PLC technology therefore, can be applied only in the great urban centers of Africa and in the communes that have cyber café or internet point, although in this case, talking about isolated buildings, the use of a transmission through power line, it would be not efficient (the electrical grid should only be modified for few uses). Besides, in the case of internet point, at least an internet connection has to be considered already active. They remain therefore, only the great urban centers and the capitals of almost all the African countries. If from a side this is restrictive limit, from the other one it could have the advantage to stimulate more and more the expansion of the electrical grid toward the suburban areas.

<u>The thefts of cables voters or the voluntary damage of the electric infrastructures</u>

The problem of the thefts of cables voters, can seem a small hassle, but matter-of-fact it is a very serious problem. Two extracts, the first one from the Sunday Telegrapg of 24/06/2007, the second one from the Deutsche Presse-Agentur of 07/11/2006, exemplify the situation of this phenomenon, respectively in South Africa and Zimbanwe.

1. [A43] Cities are being brought "to their knees" by unprecedented pilfering of copper and aluminium cables, which has caused extensive blackouts and power cuts as organised gangs plunder miles of the country's electricity and telephone lines to sell abroad as scrap. Officials believe that up to 100 miles of cables may be going missing every year, destined for markets such as China and India where booming economies have created insatiable demand for copper and aluminum. The thieves generally work by night, armed with trucks, winches, industrial cutting machines and tractors to flatten the pylons and poles that carry their booty. The result has been entire suburbs plunged into darkness, thousands of train passengers stranded, and frequent chaos on the roads as traffic lights fail. “Backed by a network of unscrupulous dealers who smelt their spoils down, many gangs are also stealing water meters, taps and even ladders”, said Cape Town councilor Pieter van Dalen. "Nobody will invest in a city if you can't rely on something as basic as an electricity supply". "The entire infrastructure, from sewerage substations to electricity generating points, are being vandalized for the sake of a few bucks." South Africa spends R500 million on replacing stolen cables every year, while the cost to firms whose power has been cut or phone lines stolen is perhaps 10 times that. The

massive increase in cable thefts in the past year is in large part due to the fact that the price of copper has tripled over the same period. Miss Nel said the gangs were highly sophisticated. "They have trucks with pulleys on them so they can roll the material while they are cutting and they are experts at blocking the electricity so they can work on the cable without getting electrocuted". For inexperienced thieves, though, the risks are high. In January last year two men were electrocuted after apparently trying to steal cable from an electricity substation. Scrap metal merchants caught with stolen cable are often charged with being in possession of "suspected" stolen material, a lesser offence than theft for which the penalty is a maximum of one year imprisonment. Under a new Second Hand Goods Act before South Africa's National Assembly, this will increase to 10 years.

2. [A44] Parts of southern Zimbabwe have been plunged into darkness after thieves stole cables from at least 17 power transmission towers, causing them to collapse. Zimbabwe now has to import an extra 23 megawatts of power from southern neighbour South Africa to supply the critical Beitbridge border post with power following the blackouts. The cash-strapped country already imports around 35 per cent of its power requirements from regional neighbours, including South Africa, Mozambique and the Democratic Republic of Congo (DRC). Part of the power line collapsed onto a railway, and electrical conductors were irreparably crushed under a train, according to the report. “The towers were vandalised by suspected thieves and this made them insecure, resulting in them collapsing in a storm on Saturday night”, a spokesman for power utility ZESA told. “It will cost us between 250 million and 300 million dollars (1 million - 1.2 million US) to reconstruct the towers and restore power to the affected areas”. As Zimbabwe sinks deeper into economic recession, thieves are finding a ready market for steel cables, copper components and even transmission oil pilfered from the country's ageing electricity transmission grid. As a result, suburbs in cities and large districts of the country suffer blackouts, and the government has scarce foreign currency to replace stolen equipment. Last week western parts of the country experienced blackouts after two towers collapsed south

of Harare following similar thefts. ZESA was last week granted leave to hike power tariffs by up to 270 per cent in a move meant to cut down on blackouts.

Figure 5-36 Power line theft leaves South Africa in dark

This phenomenon could also be extended to other types of infrastructures, nevertheless, since the electric cables are more lower and accessible part, in comparison to the wireless antennas and to the satellitaire receivers, these effects could damage the PLC services.

The very great distances

Africa is a very vast continent and the inhabited centers are small and sporadic. Because of the great distances that elapse among the inhabited centers, especially in the rural areas, length of electrical cables has to be very great. This would cause the use of many PLC repeaters (additionally, it needs to also consider the hostile environmental conditions of use: high temperature and high damp). Increasing the number of repeaters (that are among the most expensive PLC components) could bring the total cost of the infrastructure to an elevated level, upper for example to the cost required for a Wi-MAX coverage. From this, it follows that the implementation of a PLC service must be carefully valued. However, currently the electric grid is more densely present especially in populated centers, therefore, at least for now, this factor doesn't constitute a real barrier to the use of the PowerLine technology.

The rationing of the electricity and the not homogeneity of its distribution

Power rationing and cuts are part of the daily routine. Also blackouts are routine in almost all African countries (especially in the west side).

[A45] The bulk of power plants and transmission facilities were built in the 1950s and 1960s. Little investment and maintenance has left the infrastructure creaking at the seams. Nigeria, a prime example, operates at one-third of its installed capacity due to aging equipment. Wars have left equipment damaged and transmission lines cut. A large portion of Liberia's generation and distribution infrastructure was damaged or destroyed during its long civil war and the national electricity company estimates it will cost more than $107 million and take over five years to fully restore the system. Sierra Leone's Bumbuna hydroelectric project was nearly complete when civil war disrupted construction. Africa is endowed with resources vast enough to meet all its energy needs. Hydroelectricity is by far the single biggest source of electricity in a number of countries. The region possesses some of the largest water courses in the world (the Nile, Congo, Niger, Volta and Zambezi river systems). The hydro potential of the Democratic Republic of Congo alone is estimated to be sufficient to provide three times as much power as Africa currently consumes. But this potential remains largely untapped.

The non consistent distribution of the electric tension could cause serious problems for PLC based services. In the extreme cases, blackouts would completely forbid internet access, VoIP and so on. Also from this point of view, PLC technology seems to be more applicable in great urban centres, especially in South Africa, where is present Eskom.

The very low average income of the most part of Africans

Many African governments have important projects concerning the development of their own country, but almost all of them, don't have enough money and they are forced to postpone.

[A45] Experts agree that private capital is needed. The private involvement, however, raises public concerns that even if electricity works at the flick of a switch, consumers and businesses may not be able to afford service at a rate viable enough for profit-driven companies to recoup full costs. More than 40% of Africa's 600 million people live below the internationally recognized poverty line of $1 a day.

In a similar scenery it is difficult to find funds for great telecommunications works (there are many other sectors that need a higher priority, like the electrification and the distribution of water where it is still absent). Nevertheless the inexpensiveness of the PowerLine technology (at least in urban centers) could represent an advantage in comparison to other technologies.

<u>There are very few computers</u>

[A46] The environment for networked readiness has improved relatively rapidly in most urban areas in Africa. Ten years ago, only a handful of countries had local internet access or mobile telephones; now, devices and access are available in virtually every major city. The “digital divide” however, is still at its most extreme in Africa. In absolute terms, networked readiness is still at a very early stage of development compared to other regions of the world. Of the approximately 816 million people in Africa in 2001, it is estimated that only:

- one in four have a radio (200 million)
- one in 13 have a television (62 million)
- one in 35 have a mobile telephone (24 million)
- one in 39 have a fixed line (21 million)
- one in 130 have a personal computer (PC) (5.9 million)
- one in 160 use the Internet (5 million)
- one in 400 have pay-television (2 million)

These figures do not take into consideration the widespread sharing of media that takes place in Africa (often ten people may read the same newspaper or share an internet account, and a whole village may use a single telephone line or crowd around a television set at

night). Furthermore, many tax regimes still treat computers and cellular telephones as luxury items, which makes these imported items all the more expensive.
Even in South Africa, less of 10% of households have a PC, and this fraction is not likely to grow beyond 15-20% in the medium term.

[A47] The country aims for at least 5 million broadband users, amounting to a 10% penetration, over the next few years. Seen in the context of the current low fixed-line teledensity, this seems an impossible target; seen relative to mobile, it is certainly achievable. In reality, reaching such a target would require much more than investment in telecommunications. For a start, the number of computers (or similar smart terminal devices), and the number of computer-literate people would have to rise to similar levels.
Before thinking about the possibility to bring the internet access to million of Africans, it would need before to bring them electricity and computers. The African legislation in this sense doesn't help.

<u>The points of strength of the other technologies</u>
There are presently several broadband technologies options for rolling out a broadband infrastructure on the African continent: wireless technologies, including satellite, wire-line technologies (such as optical fibre networks, but also power line communications) and a combination of these.

[A47] The idea of delivering broadband access using wireless technology has been around a long time. However, it is only now that it is becoming practical and cost-effective to do so. The first broadband wireless networks were high-end, line-of-sight systems that largely replaced point-to-point microwave links. Today's broadband wireless systems are non-line-of-sight systems with increasingly mobile capability, and declining equipment prices. New wireless technologies will provide true broadband access speeds and Quality of Service. The front-runner today appears to be the Wi-MAX standard, an alignment between IEEE 802.16 and ETSI HiperMan which has the support of virtually all of the major vendors in the industry, and is being tested by numerous operators world-wide. There is certainly good reason to

believe that wireless will have an important role in delivering broadband here in Africa. Wi-MAX technology is being developed under two different standards: one for mobile deployment and the other for a fixed wireless deployment. Many telecoms players, world-wide as well as in South Africa, are in active trials or small scale deployments of Wi-MAX for "last mile" connectivity. In its fixed-wireless application, Wi-MAX promises to be the closest substitute to wire-line access, with current peak speeds of around 70 Mbits per second under ideal conditions (over short distances). Since a Wi-MAX deployment will eliminate the need to roll out wire-line telecom infrastructure all the way to the customer's premises, the installation cost, provisioning time as well as operating cost for the technology is expected to be lower, allowing for better price-points for the customer.
On the other side, the very poor coverage of the telephone fixed-line (the less developed in the world), in comparison to the mobile one, stimulates million of Africans to prefer the mobile phone to the fixed one.

[A47] Mobile operators often like to talk of 3G as broadband, but, as has been stated earlier, 3G does not provide true broadband bandwidths, and cannot match the cost per bandwidth of true broadband. Nevertheless, 3G will have an important role to play in the African market. UMTS and CDMA2000 are the two dominant 3G standards. UMTS is being deployed as a 3G overlay to GSM networks, particularly in Europe, while CDMA2000, including its evolutions such as W-CDMA and EvDO, is a natural 3G migration for CDMA networks, but is also the preferred technology of limited mobility (or “fixed-mobile”) players, since it combines a low cost per subscriber with the option of very high data speeds. Mobile technologies, particularly 3G technologies such as CDMA2000 and UMTS, will provide a practical, ubiquitous alternative to broadband at the lower end of the market. For many people in Africa, their first experience of data services will be through 3G terminals, rather than through PCs. These services will fulfill a similar role as cheap consumer broadband in developed countries. In South Africa, 3G has currently overtaken the various current broadband wireless alternatives, but over time, with the introduction of newer technologies by pioneering operators, this gap is expected to be bridged significantly.

[A48] CDMA technology is satellite-based and does not require cable wiring. The technology uses radio frequencies similar to those used by mobile phones and allows subscribers to make calls, download and send pictures, access the internet, send text messages and, with the right equipment, watch video. This is the technology that recent telecoms market entrants, Popote Wireless and Flashcom, have been using though their licences confines them to use of smart phones. With a CDMA station covering a radius of 120 km, it means Nairobi-based subscribers can for example move with their portable handsets as far as Naivasha.

The question is: will consumers prefer to buy a PC / notebook (from €300 to €600) to intensely use it, connecting themselves to internet, “chatting”, working, using to make some business, looking videos, etc.? Or will they prefer to purchase a smart phone (spending from €250 to €450) to “limit” themselves to phone, access to internet, using the e-mail services, looking multimedial contents, with less limitations owed to the encumbrance and the duration of the battery?

Figure 5-37 A typical smart phone

A confirmation of this advantage that has the 3G technology (and in general the mobile telephony based services), especially in rural areas, is given by the Bushnet technical director Malcom Brew.

[A49] “The problem with Wi-MAX at its current stage of development”, says Brew, “is that it is too expensive and requires too much power”. "Wi-MAX is not the answer yet. It may be soon, but right now it is also not fast enough or able to broadcast far enough" he says. Brew's position on Wi-MAX comes from years of working in Uganda providing wireless and technology services. He cautions the industry and regulators to be wary of the pitfalls of over-hyped new technologies. "In the big cities like Johannesburg and Lagos there is enough money to make mistakes; it's easy to swap out units and fix problems. But in the rural areas you only get one shot at making it work. There isn't enough money to make mistakes. In most cases there just isn't any money at all". The trouble is not only cost. “Right now”, he says, “Bushnet is using HSDN based on the MTN infrastructure to deliver its services and, for now, doing a better job than what Wi-MAX would be doing”. Brew warns against being prescriptive in deploying technology in Africa. "Rural African users don't need mobile Wi-MAX. They just need high-speed wireless connections. And PCs do not work in rural Africa; too much heat, dust, no electricity. The right approach? Broadband wireless access for Africa is key. Putting full-blown PCs into rural Africa is a waste of effort”.
But also the satellitaire technology has some advantages: across the African continent, satellite remains the last resort for broadband access in areas beyond the reach of terrestrial networks. But though overall costs are declining, they are still far above those of the terrestrial alternatives.

5.4.6.2 Opportunities

The most greater opportunities for the PLC market are instead:

- New projects to increase the electric production are in advanced phase.
- The fiber optics is too much expensive and a little diffused.
- There is always less interest about the satellitaire communication because of its slowness and its cost.

On January 2007, launch of the NSS8 satellite commissioned by New Skies failed and Kenyan ISP, that have lost a lot of money, are already increasing the monthly rates.

[A51] The failed launch of NSS8 not only has an impact on the business of satellite connectivity operators and providers but will also impact the overall growth of the ICT sector in Africa. Some projects relying on the bandwidth that NSS8 would have provided have already been put on hold, and many new services that telecoms and data networks planned to roll out will be postponed.

- As fibre and satellite prices are intimately related in many countries on the SAT3 route, there is now little pressure for the relevant African incumbents that own SAT3 to make an effort to lower their wholesale prices. This leaves the high-price incumbents like Angola Telecom and Camtel immune from competitive pressure.
- ADSL is a little diffused, because of the few telephone lines. Additionally, the number of fixed telephone lines is minimal and the waiting period for a telephone connection may be several years.
- Wireless technology is expanding itself and PLC systems could integrate with it.
- Market has been partly liberalized and there are now new operators reducing the costs for the final consumers.
- The telephone network is old and cannot be used for broadband services; the age of the electric network instead it is not a problem for the power line technology.

  [A05] The existing telecommunications last mile infrastructure is often too degraded to enable broadband technologies. For example Telkom's ADSL is limited to the grade of copper. The added problem is that in the built up areas where there would be a demand for bandwidth, the grade of copper is worse due to its age. The electrical network can be used for BPL/PLC as the age of the copper is not a problem. Using PLC the successful city concept could readily be achieved.
- Connectivity through power line could be furnished uncapped.

  [A47] All wireless last mile technologies, by design, divide the last mile capacity for all customers simultaneously using the service within the geographic area covered by the radio frequency, typically one of the three or four sectors on base station. While wire-line data connections [like PLC] have the guaranteed ability to be able to carry the promised speeds to each customer without contention in the last mile, wireless data connections is limited by the capacities of the operator's distribution and backbone network. The suppressed demand for content also results in limited local content development, which consequently causes a higher usage of international content. Since the international leg of the data connectivity is the most expensive component of a broadband or high-speed data service, operators in South Africa choose to "cap" the amount of international bandwidth a customer can access per month. While South Africa is not the only country where such a "capped" model exists, it is perhaps one of the very few countries where the customer does not have other models to choose from.

Additionally, while there are concerns regarding usage limits and speeds for IP-TV over services like ADSL, gated communities have the advantage of rolling out fast and uncapped local networks using technologies like Wi-Fi and Broadband over Power Lines.

- The internet access demand could increase thanks to PLC (actually people don't go to the cyber cafés because they are afraid that prices are too much high and they keep themselves distant from new technologies).
- The low-cost computers could be appreciated by the market (at least in the schools). The One Laptop For Child project is by now to the end.

  [A50] The famous laptop from almost 200 dollars is near the date of official "marketing". OLPC has realized a solid laptop, proper to warm, damp and dusty environments. Battery costs only €7, it endure to over 2,000 cycles of recharge (the battery of a common laptop exhausts itself after around 500 cycles), it allows an autonomy of 24 hours - also thanks to a consumption of the whole laptop of only 2 watts - and it can be reloaded with a small photovoltaic cell from the derisive cost of €8.50. The screen from 7.5 thumbs allows a resolution of 1200x900 pixels and is able to also work in full light with the back-lighting: in this modality, autonomy subsequently grows and legibility stays excellent. All the software applications are freely modifiable. Changes can always be annulled without consequences, making the laptop the ideal base to allow whoever to take familiarity with the programming. The mesh network is intuitive and absolutely deprived of any form of manual configuration; it allows to easily transfer documents and information, to play, “chatting” and even to use the same internet connection of any other laptop in the proximities: a tool to socialize and to share resources. Also if the new laptop won't resolve the numerous problems of Africa and all the developing countries, it can certainly lend a hand.

Figure 5-38 The OLPC's laptop from $188

- Wi-Max is not a definitive standard yet and still costs a lot.
- Satellitaire technology is expensive.
- Some changes have happened on the regulatory plan.

  [A05] Government’s involvement in broadband has been growing in recent years. The deployment of broadband infrastructure is more contingent on local context than narrowband (dial-up) has been. As the relevance of broadband internet access to local economic development and quality of life becomes increasingly evident to communities, it is expected that their involvement in the development of broadband infrastructure to continue growing. By involving local government and thereby indirectly the energy sector, PLC applications can make a valuable contribution towards the provisioning of broadband and at the same time generate the necessary revenue to bring about economic growth.

5.4.6.3 Conclusions

[A41] PowerLine Communications or PLC technology holds high potentials for the development of African telecommunication and broadband markets. Utilizing the infrastructure of our energy networks PLC can contribute to the development of Information and Communication Technology availability and adoption in several ways.

- Firstly, PLC may reach areas without other fixed line infrastructure and provide telephone and internet access to remote areas. In this context it is very likely to be used together with other alternative platforms such as fixed wireless or satellite broadband (very diffused).
- Secondly, PLC may help to provide alternative operators with a more independent means of connecting end-users by offering an alternative to the incumbent's copper network. In this context this will aid our continent to develop infrastructure competition which increases innovation, lowers prices and leads to higher levels of penetration.
- Thirdly, PLC may assist operators to distribute last mile connectivity through fixed wireless or fiber within high-rise buildings. In this context operators may use parts of the existing electrical wiring instead of deploying new and costly structured cabling.
- In addition PLC supports our energy utilities by allowing them to more efficiently manage and operate energy distribution. Accordingly this will contribute to creating an economically viable business case for PLC operation.

PLC hence presents a concrete opportunity for Africa both regarding broadband market dynamics as well as economic and citizen driven politics. Although Africa has not yet introduced projects of sizes comparable to leading international installations started in the first years of this decade, this can actually be our benefit. This is because we can actually draw on technical advances and commence activities based on third generation technology with much higher performance and far better cost structure.

5.5 Asia

5.5.1 Introduction

Demographic, economic, social and technological changes continue to change the Asian region (continent and Asian Pacific region) from a predominantly rural region to a predominantly "connected" region. The Asian region, as a whole, is experiencing a rapid development and improvement of its infrastructures; in the transport, energy, telecommunications, social services systems – and at favorable speeds as compared to other world regions in the digital divide categories, as reflected below:

5.5.1.1 Digital Divide Comparison

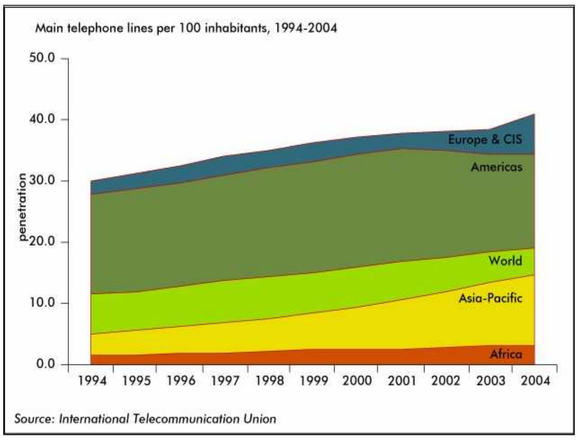


Figure 5-39 Telephone line growth by region (ITU)

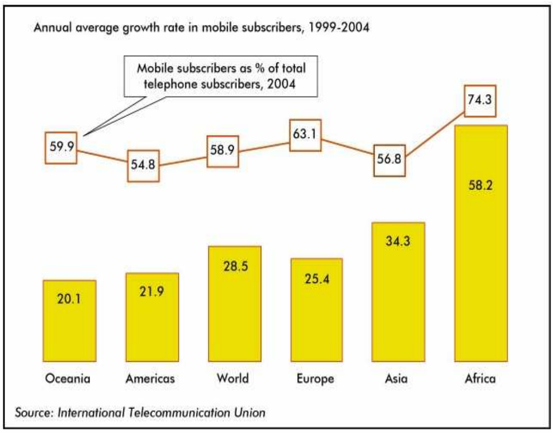


Figure 5-40 Mobile subscriber growth by region (ITU)

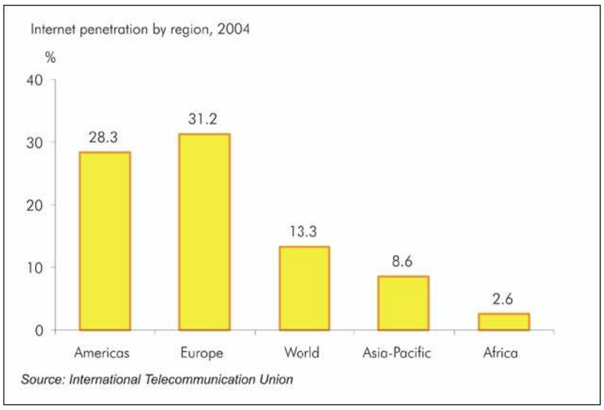


Figure 5-41 Internet penetration by region (ITU)

As in other continents, the Asian Pacific region can be divided into developed and developing nations. Accordingly, significant differences exist between the availability and the use of infrastructure resources, such as electricity and telecommunications. A brief summary of the status of the electricity and telecommunication industries follow. More details on these are found in the Appendix C.

5.5.1.2 Electricity

As Powerline communication requires an electricity infrastructure, a very brief overview on the development of the electricity industries is provided.

The next figure shows the access to electricity by region. Only Africa has a lower access per capita than some of the Asian regions in question.

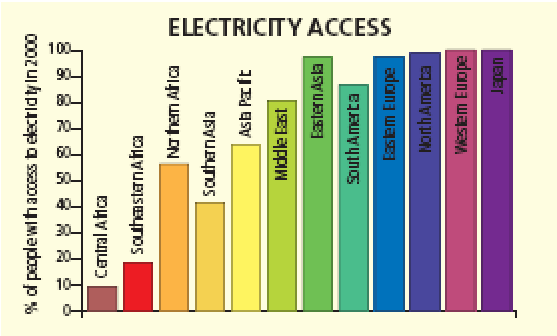


Figure 5-42 Electricity access by region

Source: Prazka Energetica 2005

Growth in demand for electricity is outstripping demand for other types of energy in the ESCAP region, as the region becomes increasingly electrified and per capita consumption rises. This trend is particularly strong in the developing countries of the region.

However the figure below shows that electricity generation in the Asian region is dominated by a few large countries, with China alone accounting for 28%. Australia, China, India, Japan, the Republic of Korea and the Russian Federation together accounted for about 87% of the total generation in the countries considered – which generally represent the developed countries.

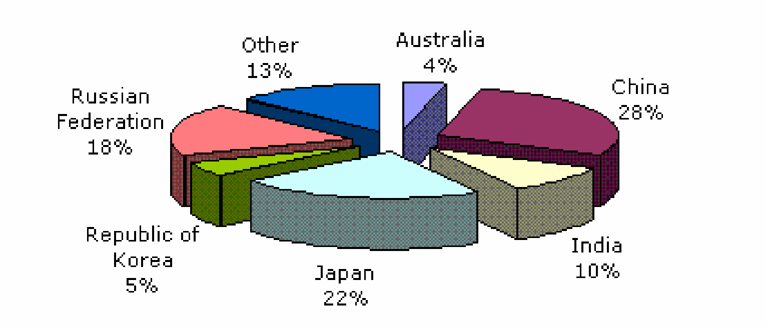


Figure 5-43 Electricity generation by country

Ref.: UNESCAP

Variations in the level of consumption per capita between developed countries and between developed and developing countries is shown below in the next figure. Electricity consumption per capita varied substantially, with the level of consumption in developed countries, such as Australia, Japan and Singapore, being more than 100 times higher than in developing countries such as India, Pakistan, Sri Lanka and Viet Nam.

These statistics imply that despite the fact that an increasing demand is being fulfilled in the developing countries, the additional use of the electricity infrastructure as a broadband carrier of telecommunications services in these regions will lag some time behind its infrastructure setup and expansion.

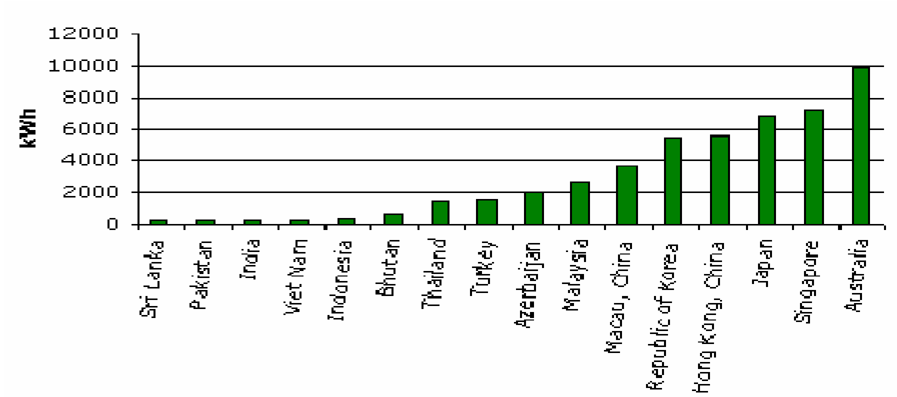


Figure 5-44 Electric power consumption by country

Ref.: UNESCAP

On the other hand, the availability of electrical infrastructure in Asia's developed nations have given rise to a number of PLC pilot projects since about the year 2000.

As will be shown later, the countries venturing into PLC in the early years of 2000 are exactly those countries with the highest electrical power consumption, beginning with South Korea, Indonesia is the exception, which also started PLC activities in 2002.

5.5.1.3 Telecommunications

The table below shows the access to information and telecommunications technologies for different regions.

Access to information and communication technologies

	Main (fixed) telephone lines per 100 population		*Mobile cellular subscribers per 100 population*		*Internet users per 100 population*	
	1990	*2005*	*1990*	*2005*	*1990*	*2005*
World	**9.9**	**19.4**	**0.2**	**34.1**	**0.3**	**15.3**
Developed	44.2	52.4	1.2	85.1	0.3	53.0
CIS	12.4	23.1	0.0	55.0	0.0	11.9
TC of SEE	13.8	24.3	0.0	62.1	0.0	18.8
Developing	3.1	13.7	0.0	25.1	0.0	8.6
Northern Africa	2.9	10.7	0.0	29.8	0.0	8.3
SSA	1.0	1.5	0.0	12.4	0.0	2.8
LAC	6.3	17.7	0.0	43.3	0.0	15.2
Eastern Asia	2.4	27.7	0.0	33.2	0.0	11.7
South Asia	0.7	5.0	0.0	8.0	0.0	5.1
SEA	1.3	8.2	0.1	25.9	0.0	9.2
Western Asia	9.8	18.1	0.1	43.1	0.0	10.5
Oceania	3.4	4.3	0.0	8.1	0.0	5.2
LDCs	0.3	0.9	0.0	5.0	0.0	1.1
LLDCs	2.3	3.0	0.0	6.8	0.0	1.7
SIDS	7.1	12.6	0.2	31.8	0.0	13.3

Note: TC of SEE= Transition countries of south-eastern Europe; SSA=Sub-Saharan Africa; LAC=Latin America and the Caribbean; SEA=South-eastern Asia; LDCs=Least Developed Countries; LLCDs=Landlocked Developing Countries; SIDS=Small Island Developing States.

Table 5-20 Access to information and telecommunications

Source: ITU, MDG Report 2007

Note the significant growth in the Asian regions which nonetheless shows a significant need for further coverage to provide an equal opportunity for citizens in remote and under supplied regions – thus providing ample opportunities for the use of PLC as a broadband technology.

The present and future role of PLC as a broadband option in Asia is described in the following paragraphs.

5.5.2 PLC Developments in Asia – Historical Perspective

5.5.2.1 Introduction

As mentioned above, it is difficult to speak about Asia as a single or coherent region when addressing such issues as digital divide, energy supply, telecommunications penetration, and of course Powerline Communications. The immensely large Asian region consists of countries at opposite ends of the scale as regards the availability of resources and the applicable environment for the development of PLC applications.

Since the early 2000s Singapore, Malaysia, Indonesia, Japan and Korea were the first to venture seriously into PLC communications – building pilot LV networks to overcome the last mile. But already then, some electricity companies (e.g. KEPCO) were interested to identify electricity network-near applications. This was evident by a continuous presence of electricity companies and service providers from Asia at international PLC conferences held in Europe in the 2002-2006 timeframe.

Major Powerline activity has been limited primarily to the developed Asian countries, i.e. to those regions and countries which already lead Asia in modern technology, and telecommunications; the most prominent being Korea, Japan, Singapore, and China.
Additionally, significant PLC projects had been started in Hong Kong, Malaysia, Indonesia and in Taiwan. In most of these countries, both the DSL and the wireless communication technologies have been the most successful competitive broadband technologies, leaving PLC for niche applications in the access area, for the in-house LAN market or for remote and undersupplied areas.

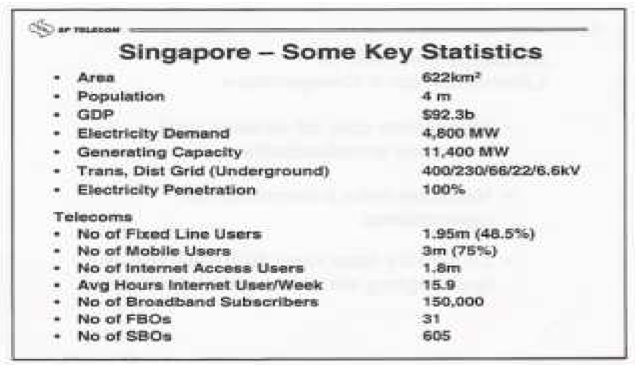
Therefore the description of PLC activity in this section of the report will focus on known projects taking place in some of the previously mentioned developed countries.

5.5.2.2 Brief Development of PLC since 2002

While research for powerline technology for overcoming the local loop had been ongoing since at least 1995, the appearance of actual PLC pilot installation by electricity companies in various Asian countries only became fully known at the beginning of the 21st century. The rationale for getting into PLC deserves a quick look back into history.

In **2002**, ***Singapore*** Power (SP), presented its PLC pilot project at an international PLC conference in Europe. SP had a 100% electricity penetration over an area of 662 km^2, servicing a population of 4 million citizens and with a generation capacity of 11400 MW. It had a three pronged strategy:

- maximize the use of assets and improve productivity
- venture into international operations
- diversify into new businesses by leveraging on core competencies



SP TELECOM

Singapore – Some Key Statistics

Area	622km²
Population	4 m
GDP	$92.3b
Electricity Demand	4,800 MW
Generating Capacity	11,400 MW
Trans, Dist Grid (Underground)	400/230/66/22/6.6kV
Electricity Penetration	100%
Telecoms	
No of Fixed Line Users	1.95m (48.5%)
No of Mobile Users	3m (75%)
No of Internet Access Users	1.8m
Avg Hours Internet User/Week	15.9
No of Broadband Subscribers	150,000
No of FBOs	31
No of SBOs	605

Figure 5-45 Singapore statistics

Source: Singapore Telecom, IQPC Conference2002

The technical PLC trial, begun in November 2000, was run by Singapore Polytechnic Institute, with Ascom (Switzerland) equipment, bandwidth of 800-2.5 MB/s and 22 users. Services offered were Fast Internet and VoIP. The feedback from the trial participants were positive, both speed (800-2.25Mb/s) and reliability were acceptable. An alternative technology to DSL and cable had established itself.

In the meantime also, Singapore Telecom was established, creating an “energy-telecom bundle” with the following assets:

- local knowledge of networking
- island-wide underground electricity infrastructure
- right of way
- infrastructure rollout organisation & management

Powerline communications then went into the second phase, with commercial high rise, residential high rise, landed residential and for industrial buildings connections. The Phase II trial was to involve 500 participants, across the island. The telecom switching gear was provided by Foundry Networks, a leading provider of high-performance enterprise and service provider switching, routing and Web traffic management solutions. Singapore Power worked closely with IDA (Info-Communications Development Authority) of Singapore, which issued a formal document << Reference Specification for Powerline Communications (PLC) Equipment >>[1] on 1 August 2003. It lay down the basic guidelines for operating frequencies and co-existence with other equipment.

Whereas Singapore Power saw PLC as a business diversification tool into telecommunications, ***Indonesia***, with a telephone penetration of 3%, recognized the PLC technology as a means to improve the telephone infrastructure in the country, for its population of 207.4 million Indonesia’s Telecommunications Act No 36/**1999** took effect in September 2000, redefining the telecom sector, and paving the way for open market competition. The Indonesian Power Utility company Persero had more than 28 million customers, a potential market for a PLC-based telephony system. AS far as Internet users were concerned, there were 3 million users in Indonesia, with a gain of 300,000 alone in **2001**.

[1] IDA RS PLC Issue 1.8.2003

PT Indonesia Comnets Plus (ICON+) was created in Oct. 3, 2000 as a wholly owned subsidiary of PT PLN (Perseo) to commercialize PLN's assets in the telco business. ICON+ obtained a service provider licence for Internet access provision. As regards telephony, ICON+ had to establish a joint venture company with a recognized telephone operator.

The PLC pilot project consisted of three stages:

1. Field trial phase 1: demonstration of PLC capabilities, and connecting 3 customers and research of the local grid.
2. Field trial phase 2: pilot installation (20 customers) and preparation of Proof of Concept.
3. Proof of concept for 400 clients in the PLN vicinity.

In cooperation with the Indonesian telephone operators PT Telekom, Indosat and Ratelindo, ICON+ estimated the installation of 2.8 million PLC-based telephones in 5 years. For the Internet, ICON+ calculated the feasibility of installing 30,000 Internet PLC customers by 2006 (dependent on the availability of PCs).
Due to the ambitious installation estimates, ICON+ recognized the potential need to have volume manufacture the PLC devices in-country.

In ***Hongkong***, after a two-year trial, Hutchison Global Communications (HGC) launched a new type of broadband service for residences in December **2002** using the electricity supply network. [2]
The Li Ka-shing fixed-line unit began to promote the PowerCom technology, owned by Cheung Kong (Holdings), after it bought out CLP Telecom in the summer. The service was launched selective areas such as Whampoa Garden in Hunghom.
The service, a first for Asia, was an alternative way for users to access broadband, and posed a new threat in the already competitive broadband market. It offered 1.5 megabits per second service at a monthly cost of HK$138 (US$17.70) in a market with prices ranging from

[2] South China Morning Post, Dec. 23, 2002

HK$68 (US$8.70) to over HK$200 (US$25.60). Users were required to lock into a seven-month contract in return for a modem, or power socket.

"This technology is now right for the Hong Kong market," a HGC official was quoted. "We will launch in selective estates before a gradual launch in other parts of the territory."

HGC would use its brand name for marketing the PowerCom Internet technology, which transmitted data, voice, and image via the electricity supply network.

The official said HGC could provide a service of up to 10Mbps, leveraging on its fibre-optic network.

China. In early 2002, the Fujian Electric Power Testing and Research Institute (FEPTRI) announced that it had developed technology to access the Internet through power lines. This development offered the potential to rapidly increase Internet usage in China. The Digitised Power Line (DPL) worked with a 180-240V power supply and reportedly provided data transmission rates of up to 10Mb/s. The technology required a special modem to link computers to the Internet, to each other or to other electrical devices such as household appliances. FEPTRI claimed its technology was faster and more reliable than similar technologies developed in other countries.

Broadband service provider FibrLink, in alliance with the State Power Telecommunications Centre, was reported to have 1,100 powerline subscribers by March 2003. FibrLink was charging 300 yuan for a powerline modem. Access speeds ranged from 512kb/s to 1.6Mb/s. Initial monthly rental charges started at 100 yuan.

California-based PowerWAN announced in March 2004 that it planned to commence deployment of a large-scale powerline carrier system in China, which would facilitate the transmission of broadband services over power lines. The company planned to install its proprietary technology in two Chinese provinces, Sichuan and Jiangsu, initially covering around 400,000 homes and businesses. Hong Kong-based International Technical Trade Company will act as the local distributor.

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In ***South Korea***, a somewhat unique situation existed as Kepco (Korea Electric Power Company), the country's major utility, had been leading the PLC development. As early as 2000, Kepco presented its development partners for both the access and home market.

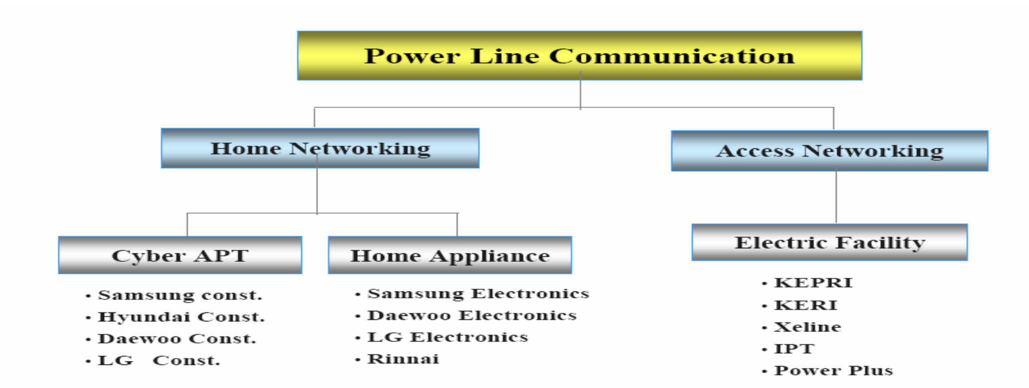

Figure 5-46 Application areas and related companies in Korea

Source: Kepco, IQPC Conference12/2002

Kepco's vision was to use its electrical infrastructure and the PLC technology for its customer base of 15,920,000 households. Applications envisioned were AMR, DAS (Distribution Automation System), DSLM (Demand Side Load Management), two-way communication channel between customer and the company and a Value Added Internet Access.

<u>Hardware Options</u>

Already by the end of 2002, Kepco had tested various speed modems from Xeline Telecom (10 MB/s), Planet (9.6 Kbps), Intellon (14MB/s), ANI (100 Kbps), Echelon (5.6 KB/s) and Domosys (9.6 KB/s).

Pilot Projects

Early pilot projects took place in Seoul and Kangwon Province (LV and MV networks) for office and private buildings, light control on the Seo-Hae Bridge (7.3 km length), an underground tunnel power control system and the construction of the trial access test-bed for Internet using a high speed PLC modem. The latter represented a test to overcome the last mile.

The findings of these PLC pilot projects were:

- PLC works on MV lines
- a test-bed was constructed for AMR after successful tests
- PLC is efficient to network for Power Automation of Utility (under 34.4 Kbps)
- Kepri will lead the study of further implementation in Korea
- the success of PLC will be determined by the ability to commercialize the technology

The subsequent development of PLC in Korea are described in section 5.5.3.2.

By 2002, low-speed BPL has been allowed in ***Japan*** for a number of years, but had not enjoyed broad acceptance.

In **mid-2004**, Japan commenced nine high-speed Internet trials using powerlines for transmission at between 2MHz and 30MHz. It is anticipated that the trial, which was set to end in March 2005, would lead to the introduction of commercial services some time in 2006.

Electromagnetic radiation leakage, radio interference problems and regulatory issues have held Japan back behind Europe and the US in BPL development, but ongoing work on frequencies and the introduction of various technologies has helped to partially overcome these problems. Strong opponents of BPL have been and continue to be amateur radio operators (see section 5.5.3.3.4.).

Some of the companies involved in the early trials have been Kyushu Electric Power Co, LineCom, Matsushita Electric Industrial Co, Mitsubishi Electric, Preminet and TEPCO. Matsushita has been working to introduce BPL adaptors for home and office, as well.
An Israeli company, ITRAN Communications, which has already been supplying low-speed BPL technology to Japan, together with two Japanese companies, formed a joint venture to offer high-speed BPL services.

5.5.3 The status of Asian PLC Projects Today

5.5.3.1 Malaysia

In its document << Deployment of Power Line Systems in Malaysia >> the Malaysian Communications and Multimedia Commission addressed the issues of technical standards and EMI without coming to a conclusion. Effectively the commission looked favorably upon the PLC technology, recognising it both as a local loop solution and for the reduction of the digital divide; yet identifying the need for standards and adherence to well defined emission limits before PLC equipment could be installed.
Subsequently, in 2006 Broadband connections using power lines were announced to be available in certain parts of the country beginning September 2006.

Realm BPL Communications Sdn Bhd, a licensed Access Services Provider, is in the midst of a pre-rollout programme to enable broadband over power lines (BPL). It is working with Realm Energy Sdn Bhd, a licensed Network Facilities Provider and Network Services Provider.
"Selected areas from Perlis to Sabah will be (broadband) connected by power line connection beginning September. And from January 2007 onwards, a mass rollout programme throughout the country will be implemented," Realm BPL chief executive officer Abdul Latif Mohd Nasir said in a statement. The technology is based on transmitting data and voice over power lines.
As this technology uses existing power lines in the houses and buildings, the potential penetration of broadband could be phenomenal, Abdul Latif added. He said BPL technology

is commercially viable and already implemented in the US, France, Germany, Spain and Hong Kong.

Extensive tests and trials were conducted in Malaysia prior to the issuance of the licences. These include streamlining guidelines, procedures, and policies.

"Obviously there were challenging issues that surfaced, like absorbing high international gateway access cost and preparing creative and useful content for users. However, the company is committed to remain competitive in servicing the market in the long term," the statement said.

5.5.3.2 Korea

Korea has the highest broadband penetration in the world and an Internet usage rate of 71.9% (July 2005).

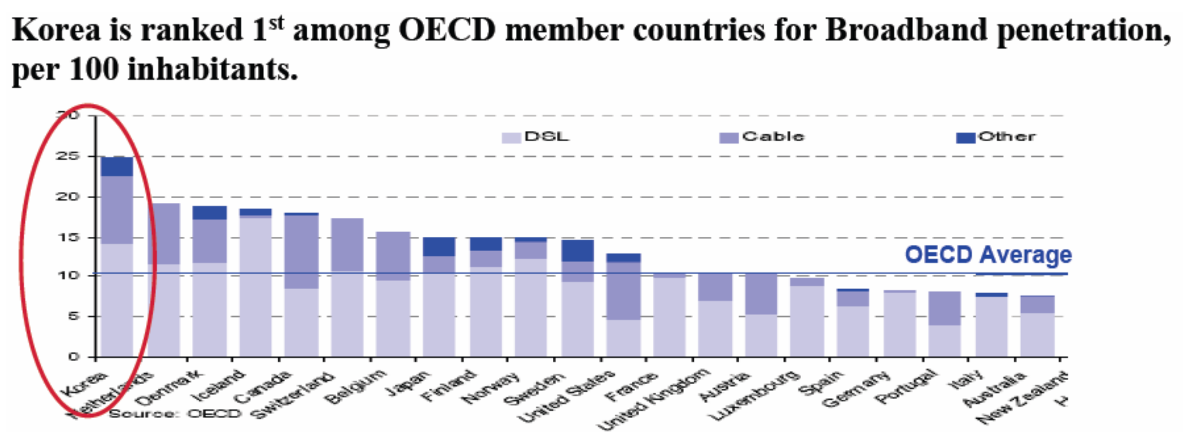

Figure 5-47 World broadband penetration

Source: Kepco, Asia PLC Conference 2007

	Download speed (Mbps)	Upload speed (Mbps)	Subscribers (Percentage)
Cable	4.97	1.11	6,722,370 (52.44)
ADSL	1.27	0.35	4,235,845 (33.04)
VDSL	5.9	3.26	1,208,263 (9.42)
Wireless LAN	3.31	2.21	653,647 (5.1)

Figure 5-48 Korean internet usage 2005

Source: Kepco, Asia PLC Conference 2007

Independent of its highly developed broadband infrastructure, Korea continues to drive the development and application of the PLC technology, developing its own PLC technology, continuing to evaluate different applications of the technology and having created the first standard for PLC equipment.

5.5.3.2.1 Hardware Development

Xeline Company Ltd. was established in 1999, and builds both PLC chipsets & modules (see the next figure), as well as application systems. Its PLC technology is a Korean technology, developed for the LV and MV networks.

Products for both the access and home network markets are being developed. A 24MB/s chip has been introduced for the commercial market. A 200 MB/s prototype chipset has also been developed. Field tests are carried by Kepco with Xeline components in 5 different regions, involving 1800 households.

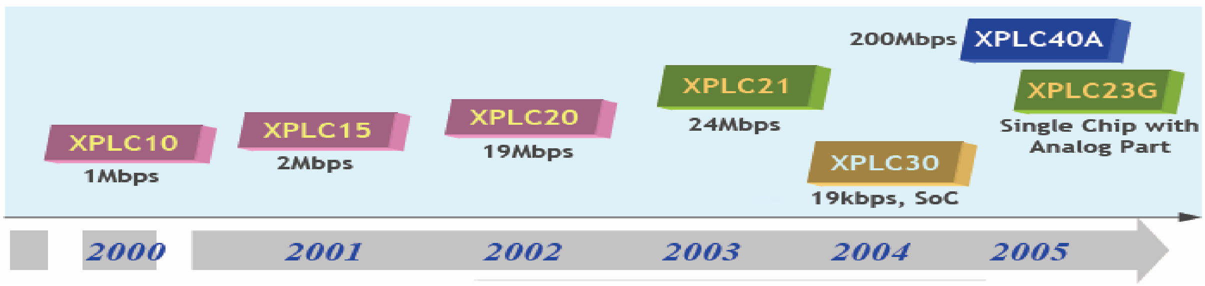

Figure 5-49 Powerline development in Korea

Source: Kepco, Asia PLC Conference 2007

Some recent milestones of Xeline are:

- Mar 2007 - Xeline Japan began to sell evaluation PLC modem named "XEVT23" using XMDL-2300 PLC module. Physical speed is up to 24Mbps. It can be applicable to surveillance camera, door phone, video phone, factory and building.XMDL-2300 using discrete multi-tone modulation method as used in xDSL is small in its size and boasts low power consumption. XEVT23 embedding XMDL-2300 PLC module is certified by Ministry of Internal Affairs and Communications in Japan. Physical speed is 24Mbps. Effective speed for TCP and UDP is 8Mbps and 14Mbps accordingly. It also has 56 bit DES encryption feature. Interface is 1 100 BASE-T, 1 RS-232/RS485. It has mechanism not to interfere with amateur ham band in Japan.
- Dec 2006 - Commercial deployment of 5000 houses for BPL AMR system with Kepco.
- Sep 2006 - Commercial release of XEUS PLC chip for smart grid systems.
- May 2006 - Internet access field trial with Thailand ISP True Corporation for 100 households in Pattaya.
- Aug 2004 - Second shipment of 6000 household devices for Fibrlink China (first shipment of 4000 units in May 2004).

5.5.3.2.2 Applications

The broad range of PLC applications as developed by Xeline is shown below:

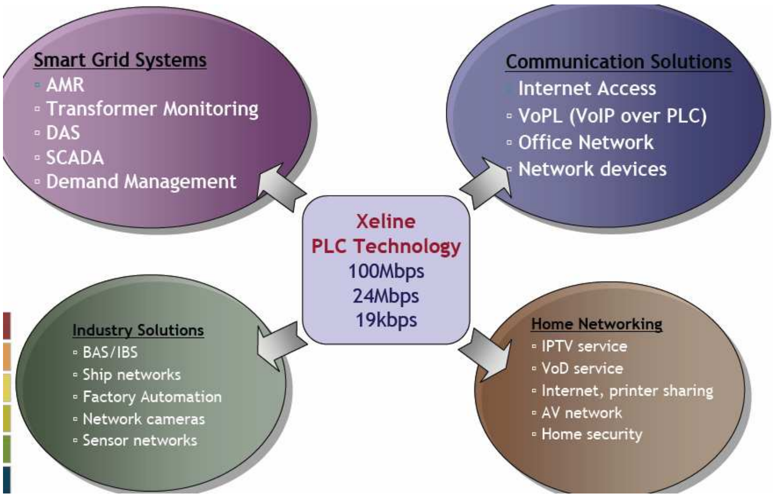

Figure 5-50 Xeline Company business areas

Source: Xeline, Asia PLC Conference 2007

AMR & Smart Grid Applications

Kepco is actively pursuing the commercialisation of PLC Smart Grid. Through Q107 Xeline has cooperated with Kepco to connect AMR units in 6500 households. The goal is to establish AMR in 16 million households. The AMR service consists of meter reading and Internet access. To date, the AMR meter success rate is 99.99%.

For Xeline Company, broadband PLC is the optimal feasible solution for the smart grid. The smart grid applications which a chip should support are:

- AMR (Automatic Meter Reading)
- DSM (Demand Side Management)
- IDS (Intelligent Distribution System)
- PQM (Power Quality Monitoring)
- Facility Diagnostics (e.g. transformer monitoring)
- Self diagnosis of malfunctioning equipment
- Energy Management System

Kepco has officially announced plans to replace all 16 million residential analog meters with PLC embedded digital AMR meters by the end of 2015. Xeline XEUS™ PLC technology is the base technology for Kepco's PLC deployment.

AS of 2005, Xeline had teamed with Samsung, KT, Sony, Sanyo and Matsushita for PLC tests inside the house. With Samsung and Sony, they discussed to embed PLC chipset inside the appliances (TV). The company finished its 1st tests, and the optimization process is under way.

5.5.3.2.3 Regulation and the PLC Standard

In December 2004, the EMI Law for PLC equipment was revised. No strict guidelines were established for in-house equipment; solely that interference with AM radio (Amplitude Modulation) and amateur radio must not be disturbed.

For outdoor PLC equipment operation, the operation of same was tightly restricted, to prevent interference with marine emergency services and air traffic control.

In December 2005, the Korean Ministry of Commerce, Industry and Energy (MOCIE) deregulated the Frequency Law, and in May 2006 established a Korean Standard (㉿) KS X 4600-1 for broadband PLC. The standardisation process involved 20 companies and organisations, including Samsung, LG, KDN, Xeline, PLC Forum Korea, KERI and Seoul National University.
The standard will be divided into 2 classes: BPL indoor and outdoor network systems (Class A), and BPL AV & Entertainment network systems (Class B). Samsung led the work for the Class B standard development which defines the PLC standards for home multimedia and networking.

5.5.3.2.4 Power & IT Project

As discussed in section 5.5.3.2.2, the Kepco supported PLC development activities eventually led to the Power & IT Project.
In a press article dated 9 December 2004 [3] the Korean Government had unveiled plans to pursue a new generation of valued-added energy business by combining electricity and IT, and announced that they will invest 500 billion won over the next 5 years for the automation, digitalization, and networking of electrical equipments based on PLC (Powerline Communication) technology.

On December 8, Hwan-ik Jo, the Vice Minister of MOCIE, officially announced the "Comprehensive Measures for the Energy IT Project" and said that "technology development and field trials were under way for the commercialization of broadband PLC within the next two years." He emphasized that "PLC is not only for the domestic market, but will also become an important export industry."

Vice Minister Jo explained that PLC has strong advantages in economical aspects, network connectivity, and in creating various new business models and therefore is favored in Korea and also internationally as the next generation communication means. In light of this, MOCIE will focus on strengthening PLC technology.

Members of the Korea Power & IT project are KERI (Korean Electrotechnology Research Institute, KDN (Korea Electric Power Network, KEPRI (Korean Electric Power Research Institute) and Xeline.

Kepco's master plan for the Power & IT project consists of three steps:

Step I:

- PBL AMR service for 16 million residential households
- Transformer monitoring for 1.5 million transformers

- Air conditioner load control for 1.6 million customers

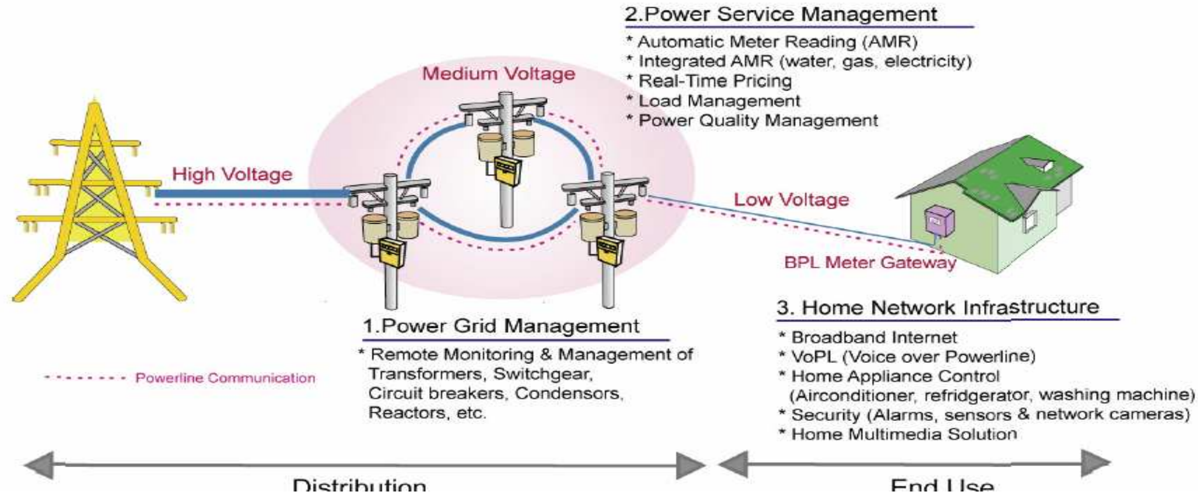

Figure 5-51 Power & IT project overview

Source: Kepco, Asia PLC Conference 2007

Step II:

- Integrated meter reading (electricity, gas, water)

Step III:

- Home service aggregator (broadband data communication services based on BPL meter gateway)

A total of 13 services are planned, based on the basic AMR service.

[3] Digital Times (www.dt.co.kr), 9 December. 2004

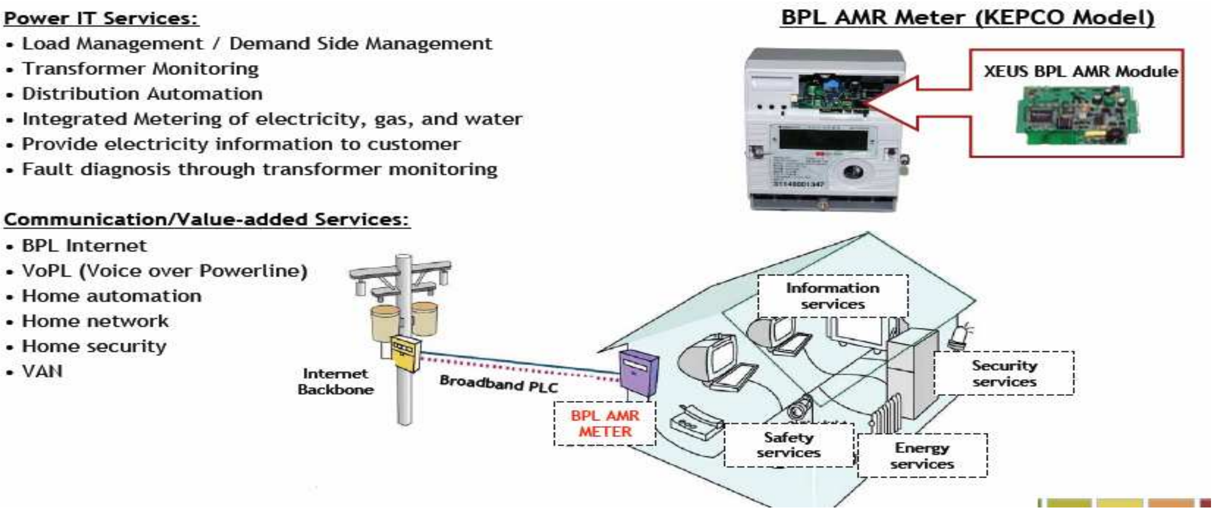

Figure 5-52 Services provided by Power & IT

Source: Kepco, Asia PLC Conference 2007

5.5.3.2.5 Future Outlook for PLC

Korea has established for itself a viable PLC industry by bringing together all PLC stakeholders: the power industry (energy suppliers), the regulatory and standardisation committees, the HW and SW manufacturing industries. The support of the government was also assured.

The rationale for the continued commitment to the Powerline technology lies in the significant financial potential for the power industry.

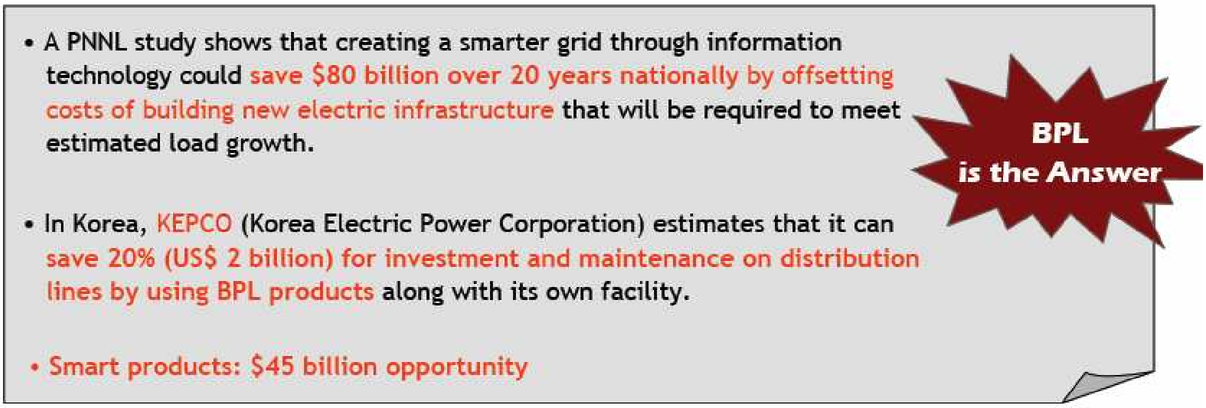

Figure 5-53 Future PLC market in Korea

Source: Xeline, Asia PLC Conference 2007

5.5.3.3 Japan

As Korea, Japan has a highly developed broadband infrastructure – which shows a strong and continuous growth.

5.5.3.3.1 Broadband Environment

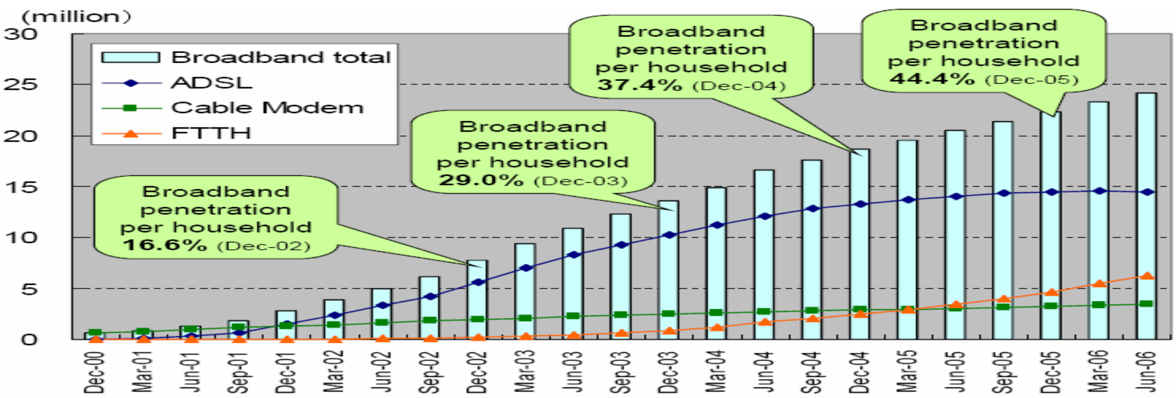

Figure 5-54 Status of broadband services in Japan

Source: MIC, 2007

Most interesting is the growth of FTTH (Fiber to the Home) which represents the steepest growth of any broadband technology.

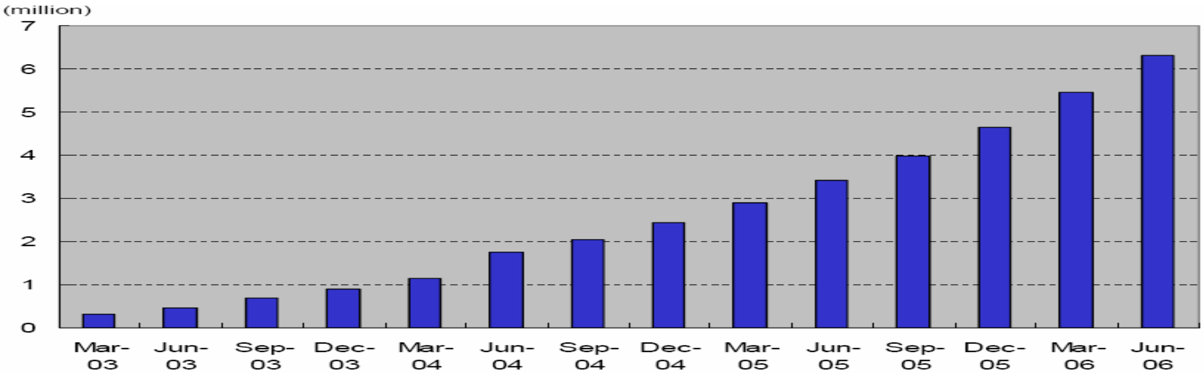

Figure 5-55 Development of FTTH subscribers

Source: MIC, 2007

The telecommunications carriers in Japan play a significant role in providing fiber as the following figure shows:

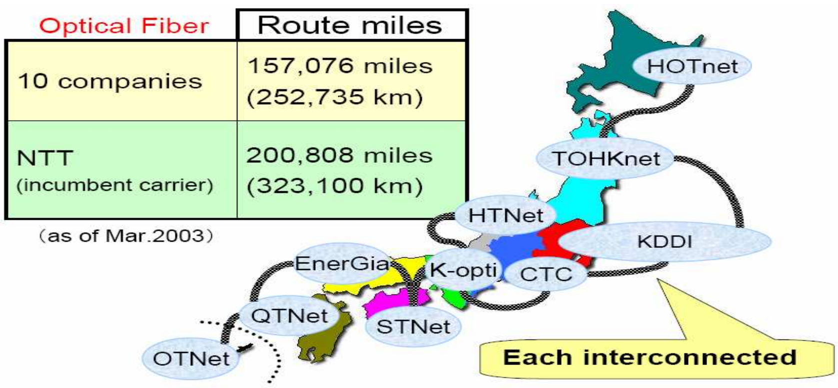

Figure 5-56 Deployment of optical fiber by power companies

Source: Tepco, Asia PLC Conference 2007

Their interconnection of carrier networks assures a country wide coverage and availability of fiber.

5.5.3.3.2 Electric Power Industry

There are 10 general electric utilities serving a population of 127 million, represented by 47.063 million households. The utilities are privately owned, vertically integrated and partially liberalized.

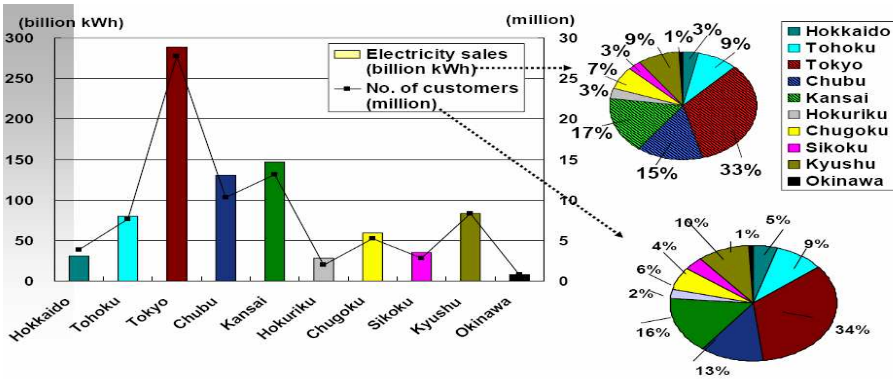

Figure 5-57 Power company market shares

Source: Tepco / Public data

One can surmise that due to the healthy growth and distribution of the above broadband technologies, the role of Powerline as an alternative access technology will be focussed in other areas.

5.5.3.3.3 Hardware Development

Sumitomo Electric

Sumitomo Electric started research into the PLC technology in 1998, and had developed a commercially available 45MB/s device by June 2004, which was delivered to Endesa in Spain.

The PLC project is currently ongoing. Following successful commercialization of its PLC modems in Spain, Sumitomo Electric started field testing in France, Portugal, Australia and ASEAN countries, while accelerating development of a successor model to the 45 Mbps modem with a transmission speed of 200 Mbps, which is on par with that of optical fiber communications. This OFDM 200MB/s device is now available commercially, for business use.

Panasonic has released an HD-PLC (Wavelet-OFDM) 190MB/s modem in December 2006.

Toyo Network Systems offers a OFDM 200MB/s modem since December 2006.

IO DATA offers a HD-PLC (Wavelet OFDM) 190 MB/s modem for home use (release December 2006).

Mitsubishi Electric offers a OFDM 200MB/s modem for business use since January 2007.

In a number of Japanese press releases during November and December 2006, it was reported that nine telecommunication carriers (among them KDDI) were providing PLC modems to their FTTH customers. The modems in question were for in-house use and supplied by Panasonic and IO DATA.

5.5.3.3.4 Regulatory Environment in Japan

In 2002, the Radio Law of Japan only allowed superposition of the signals of 450KHz or less on power lines. A PLC Study Group was founded in April of 2002 within the Japanese government to concern itself with the authorisation process of using HF band for powerline equipment. The Study Group consisted of professors, researchers from institutes and NHK. Power utility and PLC equipment manufacturers did not participate. The strongest opposition came from amateur radio operators, of which more than 1 million carried a licence. As a result of previous and subsequent tests through June 2002, the PLC Study Group concluded [4] that:

- allocation of the HF band (2 MHz – 30 MHz) for PLC is too early.
- experimental application of PLC is needed for less radiation at special permit.
- active participation in discussions on the world standards such as CISR is expected for reflecting the situation in Japan.

[4] PLC Forum http://www.plcforum.org/docs/world_summit/Reg_Japan.pdf

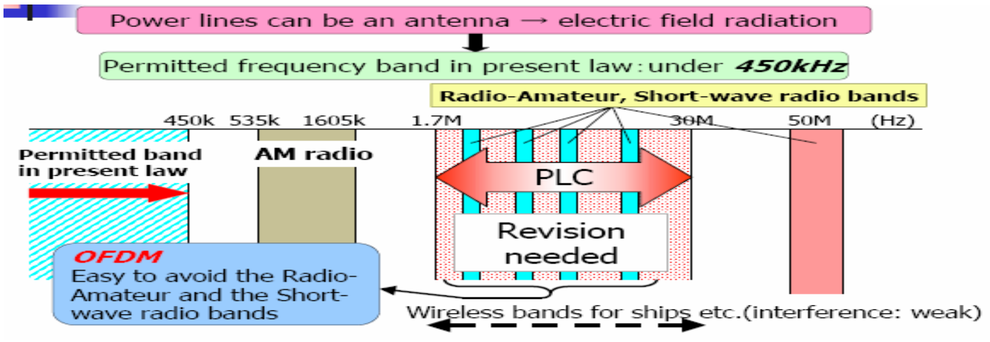

Figure 5-58 Radio law in Japan in 2002

Source: Imerge, 2004

From January 2005 through December 2005 the MIC Study Group analysed the coexistence between PLC and other HF systems to confirm its proposed limits. These were then passed to the Telecommunications Council which determined the technical conditions (January 2006-June 2006) and consequently adopted stricter limits than the Study Group. These were then passed to the Radio Regulatory Council and a statement on deregulation was issued in October 2006.

The proposed limits set for PLC indoor powerline were:

	Frequency	Quasi-peak	Average
Limits	2 - 15 MHz	30 dBuA	20 dBuA
	15 - 30 MHz	20 dBuA	10 dBuA
Measurement method	Use with impedance stabilization network (ISN) Longitudinal Conversion loss (LCL): 16dB Common mode impedance (CMZ):25Ω		

Figure 5-59 Common Mode Current (CMI) proposed limits

Source: Tepco, Asia PLC Conference 2007

The Study Group thus set CMI at less than 30 dBuA@ 2M-30MHz range. As PLC emissions exceeded ambient noise at high frequency in wooden houses, the limits for CMI @ 15M-30MHz were reduced to 20dBuA. LCL values of 16dB have been achieved in 99% of the cases.

PLC-J

Early in 2003 the PLC-J group was found, the High-Speed Power Line Promoter's Alliance of Japan. Its focus was to accelerate the acceptance of high speed PLC application in Japan.
As of September 2006, PLC-J had 13 A members (with members from the most influential and largest Japanese IT, energy and industrial manufacturing companies) and 37 B members.

Activities of PLC-J consist of the study of technical standards and measurement methods, experiments for deregulation (such as the accumulation of basic data with other HF systems, experiments).
High speed PLC continues to be promoted by PLC-J in seminars, exhibitions and by its public statements.

5.5.3.3.5 Tepco

The Tokyo Electric Power Company has been a strong supporter of the Powerline technology in Japan. The company has been involved with PLC developments since 1999. It has participated with Xeline in the development and testing of the 45MB/s and 200MB/s chips. It has started 200MB/s field tests in apartment building and in business centers, simulating both access and in-house PLC networks. Due to the limitation of the PLC technology to home applications, and the spread of broadband via FTTH and DSL, Tepco sees PLC opportunities in the home (home appliance control and monitoring – by mobile phone, and high speed LAN for triple play). For the business community, Tepco sees promising opportunities in the relatively inexpensive LAN networking and in surveillance and control applications.

5.5.3.3.6 Future Outlook for PLC in Japan

In March 2007, KDDI announced that it was collaborating with East Japan Railway to offer broadband services using the latter's cable network. The collaborators intended to offer the new service to around 120,000 households in an area covering Tokyo and northern Japan. East Japan Railway's telecoms infrastructure has been built alongside its railway tracks; additional investment would be required to connect the network to nearby customers.

The PLC development is clearly focussed on the home market, only for which operating guidelines exist. The explosive growth of FTTH coupled with PLC as the home networking technology represents the PLC application with the most business potential.

5.5.4 Conclusions

Until about 2006, PLC in Asia was mainly used for industrial control applications such as AMR and several trials for construction of communication infrastructure in the local loop in some developing countries. As the home network market grows and the need for indoor multi networking becomes greater (triple play, smart grid applications) PLC need be considered as a new alternative in home networking.

There is today a significant amount of PLC – associated research activity in Asia’s largest countries; in China, Japan, Korea and India. The smaller countries like Malaysia, Indonesia and Singapore are following the lead of the former.

The PLC development in Asia can probably best be summed up by the following statement made by Dr. Gi-Won Lee , CEO Xeline, on October 26, 2006:
”It is imperative to have indoor communication network for services such as IP TV and Home network, and ISPs recently shows interest on PLC technology." He continues to say that "PLC triumphs over the wireless solution in areas such as speed and reliability and price of PLC products will go down dramatically as demand grows larger."

The AMR market, providing a bridge for both utility applications and in-house services is expected to grow significantly. Techno Research Group in Japan estimates a PLC potential for the home market of 132 million units for the year 2010 (global base). The major customer

PLC equipment. The PLC access market has not been entirely abandoned, but as it stands at the time of this report writing, will be characterized by niche implementations.

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APPENDICES

APPENDIX A (EASTERN EUROPE)

A.1 Electricity production of the Eastern European countries.

The data are updated on November 2007 (from "CIA World FactBook").

Country	Area (km^2)	Population	Electricity (kWh)			
			Production	Consumption	Imports	Exports
Albania	28,748	3,600,523	5.385 billion	3.323 billion	371 million	300 million
Belarus	207,600	9,724,723	29.08 billion	29.49 billion	9.09 billion	5 billion
Bosnia and Herzegovina	51,129	4,552,198	12.22 billion	8.574 billion	2.174 billion	3.58 billion
Bulgaria	110,910	7,322,858	45.7 billion	37.4 billion	0	7.8 billion

Croatia	56,542	4,493,312	11.99 billion	14.97 billion	8.746 billion	3.634 billion
Cyprus	9,250	788,457	4.9 billion	4.4 billion	0	0
Czech Republic	78,866	10,228,744	77.38 billion	59.72 billion	12.35 billion	25 billion
Estonia	45,226	1,315,912	9.6 billion	6.89 billion	345 million	1.953 billion
Greece	131,940	10,706,290	56.13 billion	54.31 billion	5.616 billion	1.836 billion
Hungary	93,030	9,956,108	33.69 billion	35.98 billion	15.64 billion	9.41 billion
Latvia	64,589	2,259,810	4.78 billion	6.09 billion	2.855 billion	707 million
Lithuania	65,200	3,575,439	13.48 billion	9.296 billion	5.64 billion	8.607 billion
Macedonia	25,333	2,055,915	5.935 billion	8.93 billion	2.99 billion	0
Moldova	33,843	4,320,490	3.88 billion	5.55 billion	3.361 billion	220 million
Montenegro	14,026	684,736	2.864 billion	18.6 million	NA	NA
Poland	312,685	38,518,241	146.2 billion	120.4 billion	5 billion	16.19 billion
Romania	237,500	22,276,056	56.91 billion	48.17 billion	2.32 billion	5.224 billion
Russia	17,075,200	141,377,752	904.4 billion	779.4 billion	10.14 billion	22.52 billion
Serbia	88,361	10,150,265	33.87 billion	NA	11.23 billion	12.05 billion
Slovakia	48,845	5,447,502	29.89 billion	24.93 billion	8 billion	11.27 billion
Slovenia	20,273	2,009,245	14.9 billion	13.71 billion	4 billion	4.8 billion
Turkey	780,580	71,158,647	154.2 billion	129 billion	636 million	1.8 billion
Ukraine	603,700	46,299,862	192.1 billion	181.9 billion	20 billion	10.07 billion

Table A- 1 Electricity production of the Eastern European countries

A.2 Telephone lines and internet users in Eastern Europe

The following table shows the number of telephone main lines, mobile cellular and internet users for every Eastern European country.

The data are updated on November 2007 and taken from the "CIA World FactBook".

Country	Population	Telephones		Internet users
		Main lines use	Mobile cellular	
Albania	3,600,523	353,600	1.53 million	471,200
Belarus	9,724,723	3.368 million	5.96 million	5.478 million
Bosnia and Herzegovina	4,552,198	989,000	1.888 million	950,000
Bulgaria	7,322,858	2.399 million	8.253 million	1.87 million
Croatia	4,493,312	1.832 million	4.47 million	1.576 million
Cyprus	788,457	474,558	920,678	356,600
Czech Republic	10,228,744	3,217,300	12.15 million	3.541 million
Estonia	1,315,912	541,900	1.659 million	760,000
Greece	10,706,290	6.185 million	11.098 million	2.048 million
Hungary	9,956,108	3.35 million	9.965 million	3.5 million
Latvia	2,259,810	657,400	2.184 million	1.071 million
Lithuania	3,575,439	792,400	4.718 million	1.083 million
Macedonia	2,055,915	490,900	2.746 million	268,000
Moldova	4,320,490	1.018 million	1.417 million	727,700

Montenegro	684,736	353,300	821,800	266,000
Poland	38,518,241	11.475 million	36.746 million	11 million
Romania	22,276,056	4.386 million	13.354 million	5.063 million
Russia	141,377,752	40.1 million	120 million	25.689 million
Serbia	10,150,265	2.719 million	6.644 million	1.4 million
Slovakia	5,447,502	1.167 million	4.893 million	2.256 million
Slovenia	2,009,245	837,500	1.82 million	1.251 million
Turkey	71,158,647	18.978 million	43.609 million	12.284 million
Ukraine	46,299,862	12.341 million	49.076 million	5.545 million

Table A- 2 Telephone lines and internet users in Eastern Europe

A.3 Telephone system in Eastern Europe

The following table shows the general situation of the access to the information in the various Eastern European countries.

Data updated on 2007 and taken from the “CIA World FactBook”.

Country	Telephone system
Albania	*general assessment:* despite new investment in fixed lines, the density of main lines remains low with roughly 10 lines per 100 people; however, cellular telephone use is widespread and generally effective; combined fixed line and mobile telephone density is approximately 60 telephones per 100 persons. *domestic:* offsetting the shortage of fixed line capacity, mobile phone service has been available since 1996; by 2003 two companies were providing mobile services at a greater density than some of Albania's Balkan neighbors; Internet broadband services initiated in 2005; internet cafes are popular in Tirana and have started to spread outside the capital. *international:* country code - 355; submarine cable provides connectivity to Italy, Croatia, and Greece; the Trans-Balkan Line, a combination submarine cable and

	land fiber optic system, provides additional connectivity to Bulgaria, Macedonia, and Turkey; international traffic carried by fiber-optic cable and, when necessary, by microwave radio relay from the Tirana exchange to Italy and Greece.
Belarus	*general assessment:* Belarus lags behind its neighbors in upgrading telecommunications infrastructure; state-owned Beltelcom is the sole provider of fixed-line local and long distance service; fixed-line teledensity of 33 per 100 persons; mobile-cellular telephone density of 58 per 100 persons; modernization of the network progressing with roughly two-thirds of switching equipment now digital. *domestic:* fixed-line penetration is improving although rural areas continue to be underserved; 4 GSM wireless networks are experiencing rapid growth; strict government controls on telecommunications technologies. *international:* country code - 375; Belarus is a member of the Trans-European Line (TEL), Trans-Asia-Europe (TAE) fiber-optic line, and has access to the Trans-Siberia Line (TSL); 3 fiber-optic segments provide connectivity to Latvia, Poland, Russia, and Ukraine; worldwide service is available to Belarus through this infrastructure; additional analog lines to Russia; Intelsat, Eutelsat, and Intersputnik earth stations.
Bosnia and Herzegovina	*general assessment:* telephone and telegraph network needs modernization and expansion; many urban areas are below average as contrasted with services in other former Yugoslav republics. *domestic:* fixed-line teledensity is roughly 20 per 100 persons; mobile-cellular telephone density is about 22 per 100 persons. *international:* country code - 387; no satellite earth stations.
Bulgaria	*general assessment:* an extensive but antiquated telecommunications network inherited from the Soviet era; quality has improved; the Bulgaria Telecommunications Company's fixed-line monopoly terminated in 2005 when alternative fixed-line operators were given access to its network; a drop in fixed-line connections in recent years has been offset by a sharp increase in mobile-cellular telephone use fostered by multiple service providers. *domestic:* a fairly modern digital cable trunk line now connects switching centers in most of the regions; the others are connected by digital microwave radio relay. *international:* country code - 359; submarine cable provides connectivity to Ukraine and Russia; a combination submarine cable and land fiber-optic system provides connectivity to Italy, Albania, and Macedonia; satellite earth stations - 1 Intersputnik (Atlantic Ocean region); 2 Intelsat (Atlantic and Indian Ocean regions).
Croatia	*general assessment:* NA *domestic:* reconstruction plan calls for replacement of all analog circuits with digital and enlarging the network; a backup will be included in the plan for the main trunk. *international:* country code - 385; digital international service is provided through the main switch in Zagreb; Croatia participates in the Trans-Asia-Europe (TEL) fiber-optic project, which consists of 2 fiber-optic trunk connections with Slovenia and a fiber-optic trunk line from Rijeka to Split and Dubrovnik; Croatia is also investing in ADRIA 1, a joint fiber-optic project with Germany, Albania, and Greece.

Cyprus	*general assessment:* excellent in both area under government control and area administered by Turkish Cypriots. *domestic:* open-wire, fiber-optic cable, and microwave radio relay. *international:* country code - 357 (area administered by Turkish Cypriots uses the country code of Turkey - 90); tropospheric scatter; 3 coaxial and 5 fiber-optic submarine cables; satellite earth stations - 3 Intelsat (1 Atlantic Ocean and 2 Indian Ocean), 2 Eutelsat, 2 Intersputnik, and 1 Arabsat.
Czech Republic	*general assessment:* privatization and modernization of the Czech telecommunication system got a late start but is advancing steadily; growth in the use of mobile cellular telephones is particularly vigorous. *domestic:* 86% of exchanges now digital; existing copper subscriber systems now being enhanced with Asymmetric Digital Subscriber Line (ADSL) equipment to accommodate Internet and other digital signals; trunk systems include fiber-optic cable and microwave radio relay. *international:* country code - 420; satellite earth stations - 2 Intersputnik (Atlantic and Indian Ocean regions), 1 Intelsat, 1 Eutelsat, 1 Inmarsat, 1 Globalstar.
Estonia	*general assessment:* foreign investment in the form of joint business ventures greatly improved telephone service; substantial fiber-optic cable systems carry telephone, TV, and radio traffic in the digital mode; Internet services are available throughout most of the country. *domestic:* a wide range of high quality voice, data, and Internet services is available throughout the country. *international:* country code - 372; fiber-optic cables to Finland, Sweden, Latvia, and Russia provide worldwide packet-switched service; 2 international switches are located in Tallinn.
Greece	*general assessment:* adequate, modern networks reach all areas; good mobile telephone and international service. *domestic:* microwave radio relay trunk system; extensive open-wire connections; submarine cable to offshore islands. *international:* country code - 30; tropospheric scatter; 8 submarine cables; satellite earth stations - 2 Intelsat (1 Atlantic Ocean and 1 Indian Ocean), 1 Eutelsat, and 1 Inmarsat (Indian Ocean region).
Hungary	*general assessment:* the telephone system has been modernized and is capable of satisfying all requests for telecommunication service. *domestic:* the system is digitalized and highly automated; trunk services are carried by fiber-optic cable and digital microwave radio relay; a program for fiber-optic subscriber connections was initiated in 1996; heavy use is made of mobile cellular telephones. *international:* country code - 36; Hungary has fiber-optic cable connections with all neighboring countries; the international switch is in Budapest; satellite earth stations - 2 Intelsat (Atlantic Ocean and Indian Ocean regions), 1 Inmarsat, 1 very small aperture terminal (VSAT) system of ground terminals.

Latvia	*general assessment:* recent efforts focused on bringing competition to the telecommunications sector, beginning in 2003; the number of fixed lines is decreasing as wireless telephony expands. *domestic:* 3 wireless service providers including Lattelekom, the incumbent monopoly. *international:* country code - 371; the Latvian network is now connected via fiber optic cable to Estonia, Finland, and Sweden.
Lithuania	*general assessment:* inadequate, but is being modernized to provide an improved international capability and better residential access. *domestic:* a national, fiber-optic cable, interurban, trunk system is nearing completion; rural exchanges are being improved and expanded; mobile cellular systems are being installed; access to the Internet is available; still many unsatisfied telephone subscriber applications. *international:* country code - 370; landline connections to Latvia and Poland; major international connections to Denmark, Sweden, and Norway by submarine cable for further transmission by satellite.
Macedonia	*general assessment:* NA *domestic:* NA *international:* country code - 389
Moldova	*general assessment:* inadequate, outmoded, poor service outside Chisinau; some modernization is under way. *domestic:* depending on location, new subscribers may face long wait for service; 2 private operators of GSM mobile cellular telephone service are operating; GPRS system is being introduced; license for 1 CDMA mobile telephone network currently being tendered. *international:* country code - 373; service through Romania and Russia via landline; satellite earth stations - Intelsat, Eutelsat, and Intersputnik.
Montenegro	*general assessment:* modern telecommunications system with access to European satellites. *domestic:* GSM wireless service, available through 2 providers with national coverage, is growing rapidly. *international:* country code - 382 (the old code of 381 used by Serbia and Montenegro will also remain in use until Feb 2007); 2 international switches connect the national system.
Poland	*general assessment:* modernization of the telecommunications network has accelerated with market based competition finalized in 2003; fixed-line service, dominated by the former state-owned company, is dwarfed by the growth in wireless telephony. *domestic:* wireless service, available since 1993 (GSM service available since 1996) and provided by three nation-wide networks, has grown rapidly in response to the weak fixed-line coverage; third generation UMTS service available in urban areas;

	cellular coverage is generally good with more gaps in the east; fixed-line service is growing slowly and still lags in rural areas. *international:* country code - 48; international direct dialing with automated exchanges; satellite earth station - 1 with access to Intelsat, Eutelsat, Inmarsat, and Intersputnik.
Romania	*general assessment:* rapidly improving domestic and international service, especially in wireless telephony. *domestic:* 90% of telephone network is automatic; liberalization in 2003 is transforming telecommunications; there has been 20% growth in fixed lines with a penetration rate of 58% of households; nation-wide wireless service is growing even faster with 4 major providers and a penetration rate of 32%. *international:* country code - 40; satellite earth stations - 10; digital, international, direct-dial exchanges operate in Bucharest.
Russia	*general assessment:* the telephone system is experiencing significant changes; there are more than 1,000 companies licensed to offer communication services; access to digital lines has improved, particularly in urban centers; Internet and e-mail services are improving; Russia has made progress toward building the telecommunications infrastructure necessary for a market economy; the estimated number of mobile subscribers jumped from fewer than 1 million in 1998 to 120 million in 2005; a large demand for main line service remains unsatisfied, but fixed-line operators continue to grow their services. *domestic:* cross-country digital trunk lines run from Saint Petersburg to Khabarovsk, and from Moscow to Novorossiysk; the telephone systems in 60 regional capitals have modern digital infrastructures; cellular services, both analog and digital, are available in many areas; in rural areas, the telephone services are still outdated, inadequate, and low density. *international:* country code - 7; Russia is connected internationally by 3 undersea fiber-optic cables; digital switches in several cities provide more than 50,000 lines for international calls; satellite earth stations provide access to Intelsat, Intersputnik, Eutelsat, Inmarsat, and Orbita systems.
Serbia	*general assessment:* modernization of the telecommunications network has been slow as a result of damage stemming from the 1999 war and transition to a competitive market-based system; network was only 65% digitalized in 2005. *domestic:* teledensity remains below the average for neighboring states; GSM wireless service, available through 2 providers with national coverage, is growing very rapidly; best telecommunications service limited to urban centers. *international:* country code - 381.
Slovakia	*general assessment:* Slovakia has a modern telecommunications system that has expanded dramatically in recent years with the growth in cellular services. *domestic:* analog system is now receiving digital equipment and is being enlarged with fiber-optic cable, especially in the larger cities; 3 companies provide nationwide cellular services. *international:* country code - 421; 3 international exchanges (1 in Bratislava and 2 in

	Banska Bystrica) are available; Slovakia is participating in several international telecommunications projects that will increase the availability of external services.
Slovenia	*general assessment:* NA *domestic:* 100% digital *international:* country code - 386
Turkey	*general assessment:* undergoing rapid modernization and expansion especially with cellular telephones. *domestic:* additional digital exchanges are permitting a rapid increase in subscribers; the construction of a network of technologically advanced intercity trunk lines, using both fiber-optic cable and digital microwave radio relay, is facilitating communication between urban centers; remote areas are reached by a domestic satellite system; the number of subscribers to mobile cellular telephone service is growing rapidly. *international:* country code - 90; international service is provided by 3 submarine fiber-optic cables in the Mediterranean and Black Seas, linking Turkey with Italy, Greece, Israel, Bulgaria, Romania, and Russia; satellite earth stations - 12 Intelsat; mobile satellite terminals - 328 in the Inmarsat and Eutelsat systems.
Ukraine	*general assessment:* Ukraine's telecommunication development plan, running through 2005, emphasizes improving domestic trunk lines, international connections, and the mobile cellular system. *domestic:* at independence in December 1991, Ukraine inherited a telephone system that was antiquated, inefficient, and in disrepair; more than 3.5 million applications for telephones could not be satisfied; telephone density is rising slowly and the domestic trunk system is being improved; the mobile cellular telephone system is expanding at a high rate. *international:* country code - 380; 2 new domestic trunk lines are a part of the fiber-optic Trans-Asia-Europe (TAE) system and 3 Ukrainian links have been installed in the fiber-optic Trans-European Lines (TEL) project that connects 18 countries; additional international service is provided by the Italy-Turkey-Ukraine-Russia (ITUR) fiber-optic submarine cable and by earth stations in the Intelsat, Inmarsat, and Intersputnik satellite systems.

Table A- 3 Telephone system in Eastern Europe

A.4 TLC operators and broadcast station number in Eastern Europe

The data of the TLC operators are taken from “ITU World Telecommunication Regulatory Database” and are updated on 2007, while the data of the number of the Radio & TV broadcast stations and the internet connections broadband are taken from “CIA World FactBook” and are updated on November 2007.

Country	Operator	Status	Broadcast Stations & Broadband Connections		
			Radio	TV	Internet
Albania	Albtelecom	State-owned	13 AM, 46 FM, 1 SW	67	300
Belarus	RUE “Beltelecom”	State-owned	28 AM, 37 FM, 11 SW	47	11.4 million
Bosnia and Herzegovina	BH Telecom Sarajevo	Partially private	8 AM, 16 FM, 1 SW	33	40 million
Bulgaria	Bulgarian Telecommunications Company (BTC)	Partially private	31 AM, 63 FM, 2 SW	39	384.3 million
Croatia	Croatian Telecom Inc. (HT)	Partially private	16 AM, 98 FM, 5 SW	36	251.8 million
Cyprus	Otenet (Cyprus) Ltd.	Partially private	6 AM, 96 FM, 1 SW	10	49.6 million
Czech Republic	Telefonica O2 Czech Republic	Partially private	31 AM, 304 FM, 17 SW	150	1.086 billion
Estonia	Elion AS	Partially private	0 AM, 98 FM, 0 SW	3	228.1 million
Greece	OTE (Hellenic Telecommunications Organisation)	Partially private	26 AM, 88 FM, 4 SW	38	487.9 million
Hungary	Magyar Telekom	Fully private	17 AM, 57 FM, 3 SW	35	976.7 million
Latvia	Lattelecom	Partially private	8 AM, 56 FM, 1 SW	44	109.7 million
Lithuania	Teo LT, AB	Partially private	29 AM, 142 FM, 1 SW	27	368.7 million
Macedonia	AD Makedonski Telekomunikacii	Partially private	29 AM, 20 FM, 0 SW	31	36.5 million

Moldova	Moldtelecom	State-owned	2 AM, 29 FM	40	21.8 million
Montenegro	T-Com Montenegro	Fully private	31	13	25.8 million
Poland	Telekomunikacja Polska SA	Partially private	14 AM, 777 FM, 1 SW	40	2.64 billion
Romania	SC Romtelecom SA	Partially private	40 AM, 202 FM, 3 SW	48	1.77 billion
Russia	Svyazinvest	State-owned	323 AM, 1500 FM, 62 SW	7,306	2.9 billion
Serbia	Telekom Srbija	Partially private	153	NA 11.23 billion	121.7 billion
Slovakia	Slovak Telecom AS	Partially private	15 AM, 78 FM, 2 SW	80	317 million
Slovenia	Telekom Slovenije	Partially private	10 AM, 230 FM, 0 SW	31	263.7 million
Turkey	Türk Telekomünikasyon AS	Partially private	16 AM, 107 FM, 6 SW	635	2.77 billion
Ukraine	Ukranian Telecom Corporation	State-owned	524	647	NA

Table A- 4 TLC operators and broadcast station number in Eastern Europe

A.5 Broadband penetration in Eastern Europe

This table shows the broadband penetration of the internet services among the population and the growth of this technology in the last 7 years. The data are taken from “Internet Usage in Europe” and are updated on September 2007.

The other columns show the percentage over 1,000 people of the diffusion of radios, TVs, mobile phones and Personal Computers. Data are from “International Telecommunication Union, World Telecommunication Development Report 1999”.

Country	Broadband penetration	Usage growth (2000-2007)	Items per 1,000 people			
			Radio	TV	Mobile phones	PC
Albania	15.3 %	18748 %	217	109	1	NA
Belarus	56.6 %	2943 %	296	314	1	NA
Bosnia and Herzegovina	20.3 %	13471 %	248	41	7	NA
Bulgaria	28.7 %	411 %	543	398	15	NA
Croatia	35.3 %	688 %	336	272	41	112
Cyprus	36.7 %	197 %	NA	NA	NA	NA
Czech Republic	50.0 %	410 %	803	447	94	97
Estonia	51.8 %	88 %	NA	NA	NA	NA
Greece	33.5 %	280 %	NA	NA	NA	NA
Hungary	30.4 %	326 %	689	437	105	59
Latvia	45.2 %	586 %	NA	NA	NA	NA
Lithuania	35.9 %	443 %	NA	NA	NA	NA
Macedonia	19.1 %	1209 %	200	250	15	NA
Moldova	14.8 %	2100 %	740	297	2	6
Montenegro	17.6 %	NA	NA	NA	NA	NA

Poland	29.9 %	307 %	523	413	50	44
Romania	23.4 %	517 %	319	233	29	10
Russia	19.5 %	803 %	418	420	5	41
Serbia	13.9 %	250 %	297	259	23	19
Slovakia	46.5 %	284 %	NA	NA	NA	NA
Slovenia	55.5 %	263 %	406	356	84	251
Turkey	21.1 %	700 %	NA	NA	NA	NA
Ukraine	11.5 %	2539 %	884	490	2	14

Table A- 5 Broadband penetration in Eastern Europe

APPENDIX B (AFRICA)

B.1 Electricity production of the African countries.

The data of the population are updated on July 2007 and those about electricity (express in kWh) on 2004. Source: “CIA World FactBook”.

Country	Area (km^2)	Population	Electricity			
			Production	Consumption	Imports	Exports
Algeria	2,381,745	33,333,216	29,39 billion	27.4 billion	300 million	230 million
Angola	1,246,700	12,263,596	2,194 billion	2.04 billion	0	0
Benin	112,622	8,078,314	82 million	576.3 million	500 million	0
Botswana	575,000	1,815,508	823 million	2.464 billion	1.699 billion	0

Burkina Faso	274,122	14,326,203	400 million	372 million	0	0
Burundi	27,834	8,390,505	37 million	157.4 million	30 million	0
Cameroon	475,500	18,060,382	3,924 billion	3.649 billion	0	0
Cape Verde	4,033	423,613	44 million	40.92 million	0	0
Central African Rep.	624,977	4,369,038	109 million	101.4 million	0	0
Chad	1,284,000	9,885,661	94 million	87.42 million	0	0
Comoros	1,862	711,417	19 million	17.67 million	0	0
Congo	342,000	3,800,610	6,847 billion	5.127 billion	9 million	1.25 billion
DR Congo	2,345,410	65,751,512	353 million	658.3 million	330 million	0
Cote d'Ivoire	322,463	18,013,409	4,625 billion	3.202 billion	0	1.1 billion
Djibouti	22,000	496,374	200 million	186 million	0	0
Egypt	1,000,250	80,335,036	91,72 billion	84.49 billion	200 million	1 billion
Equatorial Guinea	28,051	551,201	26 million	24.18 million	0	0
Eritrea	93,679	4,906,585	276,1 million	256.7 million	0	0
Ethiopia	1,106,000	76,511,887	2,294 billion	2.133 billion	0	0
Gabon	267,667	1,454,867	1,543 billion	1.435 billion	0	0
Gambia	10,689	1,688,359	145 million	134.9 million	0	0
Ghana	238,537	22,931,299	6,489 billion	7.095 billion	1.96 billion	900 million
Guinea	245,855	9,947,814	840 million	832.9 million	0	0
Guinea-Bissau	36,125	1,472,780	58,02 million	53.96 million	0	0

Kenya	582,644	36,913,721	5,709 billion	5.459 billion	150 million	0
Lesotho	30,344	2,125,262	250 million	244.5 million	12 million	0
Liberia	111,370	3,195,931	325 million	302.3 million	0	0
Libya	1,759,540	6,036,914	19,44 billion	18.08 billion	0	0
Madagascar	594,180	19,448,815	984 million	915.1 million	0	0
Malawi	94,081	13,603,181	1,293 billion	1.202 billion	0	0
Mali	1,240,142	11,995,402	410 million	381.3 million	0	0
Mauritania	1,030,700	3,270,065	176,7 million	164.3 million	0	0
Mauritius	1,868	1,250,882	2,107 billion	1.96 billion	0	0
Morocco	659,970	33,757,175	18,48 billion	18.89 billion	1.7 billion	0
Mozambique	784,754	20,905,585	11,58 billion	9.592 billion	7.576 billion	8.75 billion
Namibia	824,293	2,055,080	1,397 billion	2.819 billion	1.6 billion	80 million
Niger	1,186,408	12,894,865	232 million	415.8 million	200 million	0
Nigeria	923,850	135,031,164	19,06 billion	17.71 billion	0	20 million
Rwanda	26,330	9,907,509	93 million	196.5 million	120 million	10 million
Sao Tome and Principe	964	199,579	18 million	16.74 million	0	0
Senegal	196,722	12,521,851	1,453 billion	1.351 billion	0	0
Seychelles	404	81,895	208 million	193.4 million	0	0
Sierra Leone	72,326	6,144,562	244 million	226.9 million	0	0
Somalia	630,000	9,118,773	269 million	250.2 million	0	0

South Africa	1,219,912	43,997,828	227,2 billion	207 billion	8.026 billion	12.4 billion
Sudan	2,505,815	39,379,358	3,845 billion	3.576 billion	0	0
Swaziland	17,366	1,133,066	156,3 million	1.123 billion	697 million	0
Tanzania	945,087	39,384,223	2,562 billion	2.383 billion	0	0
Togo	56,785	5,701,579	286,2 million	929.2 million	663 million	0
Tunisia	161,148	10,276,158	11,81 billion	10.97 billion	5 million	15 million
Uganda	236,000	30,262,610	1,894 billion	1.596 billion	0	165 million
Zambia	752, 617	11,477,447	9,962 billion	6.692 billion	403 million	2.975 billion
Zimbabwe	390,310	12,311,143	9,412 billion	11 billion	2.25 billion	0

Table B- 1 Electricity production of the African countries

B.2 Telephone lines and internet users in Africa

The following table shows the number of telephone main lines, mobile cellular and internet users for every African country.

The data are updated on 2006 and taken from the “CIA World FactBook”.

Country	Population	Telephones		Internet users
		Main lines use	Mobile cellular	
Algeria	33,333,216	2.841 million	20.998 million	2,460,000
Angola	12,263,596	98,200	2.264 million	85,000
Benin	8,078,314	76,300	750,000	700,000

Botswana	1,815,508	136,900	979,800	60,000
Burkina Faso	14,326,203	94,800	1.017 million	80,000
Burundi	8,390,505	31,100	153,000	60,000
Cameroon	18,060,382	100,300	2,253	370,000
Cape Verde	423,613	71,600	108,900	29,000
Central African Rep.	4,369,038	10,000	100,000	13,000
Chad	9,885,661	13,000	466,100	60,000
Comoros	711,417	16,900	16,100	21,000
Congo	3,800,610	15,900	490,000	70,000
DR Congo	65,751,512	10,600	2.746 million	180,000
Cote d'Ivoire	18,013,409	260,900	4.065 million	300,000
Djibouti	496,374	10,800	44,100	11,000
Egypt	80,335,036	10.808 million	18.001 million	6,000,000
Equatorial Guinea	551,201	10,000	96,900	8,000
Eritrea	4,906,585	37,700	62,000	100,000
Ethiopia	76,511,887	725,000	866,700	164,000
Gabon	1,454,867	36,500	764,700	81,000
Gambia	1,688,359	52,900	404,300	58,000
Ghana	22,931,299	356,400	5.207 million	609,800
Guinea	9,947,814	26,300	189,000	50,000

Guinea-Bissau	1,472,780	10,200	95,000	37,000
Kenya	36,913,721	293,400	6.485 million	2,770,000
Lesotho	2,125,262	48,000	249,800	51,500
Liberia	3,195,931	6,900	160,000	1,000
Libya	6,036,914	483,000	3.928 million	232,000
Madagascar	19,448,815	129,800	1.046 million	110,000
Malawi	13,603,181	102,700	429,300	59,700
Mali	11,995,402	75,000	869,600	70,000
Mauritania	3,270,065	34,900	1.06 million	100,000
Mauritius	1,250,882	357,300	772,400	182,000
Morocco	33,757,175	1.266 million	16.005 million	6,100,000
Mozambique	20,905,585	67,000	2.339 million	178,000
Namibia	2,055,080	138,900	495,000	80,600
Niger	12,894,865	24,000	323,900	40,000
Nigeria	135,031,164	1.688 million	32.322 million	8,000,000
Rwanda	9,907,509	22,000	290,000	65,000
Sao Tome & Principe	199,579	7,100	12,000	23,000
Senegal	12,521,851	282,600	2.983 million	650,000
Seychelles	81,895	20,700	70,300	29,000
Sierra Leone	6,144,562	24,000	113,200	10,000

Somalia	9,118,773	100,000	500,000	94,000
South Africa	43,997,828	4.729 million	33.96 million	5,100,000
Sudan	39,379,358	636,900	4.683 million	3,500,000
Swaziland	1,133,066	44,000	250,000	41,600
Tanzania	39,384,223	169,135	6.72 million	384,300
Togo	5,701,579	82,100	708,000	320,000
Tunisia	10,276,158	1.268 million	7.339 million	1,295,000
Uganda	30,262,610	108,100	2.009 million	750,000
Zambia	11,477,447	94,700	949,600	334,800
Zimbabwe	12,311,143	331,700	832,500	1,220,000

Table B- 2 Telephone lines and internet users in Africa

B.3 Telephone system in Africa

The following table shows the general situation of the access to the information in the various African countries.

Data updated on 2006 and taken from the “CIA World FactBook”.

Country	Telephone system
Algeria	*general assessment:* telephone density in Algeria is very low, not exceeding 5 telephones per 100 persons; the number of fixed main lines increased in the last few years to nearly 2.6 million, but only about two-thirds of these have subscribers; much of the infrastructure is outdated and inefficient *domestic:* good service in north but sparse in south; domestic satellite system with 12 earth stations (20 additional domestic earth stations are planned) *international:* country code - 213; submarine cables - 5; microwave radio relay to Italy, France, Spain, Morocco, and Tunisia; coaxial cable to Morocco and Tunisia; participant in Medarabtel; satellite earth stations - 51 (Intelsat, Intersputnik, and

	Arabsat)
Angola	*general assessment:* telephone service limited mostly to government and business use; HF radiotelephone used extensively for military links *domestic:* limited system of wire, microwave radio relay, and tropospheric scatter *international:* country code - 244; satellite earth stations - 29; fiber optic submarine cable (SAT-3/WASC) provides connectivity to Europe and Asia
Benin	*general assessment:* NA *domestic:* fair system of open-wire, microwave radio relay, and cellular connections *international:* country code - 229; satellite earth station - 7 (Intelsat-Atlantic Ocean); fiber optic submarine cable (SAT-3/WASC) provides connectivity to Europe and Asia
Botswana	*general assessment:* the system is expanding with the growth of mobile cellular service and participation in regional development *domestic:* small system of open-wire lines, microwave radio relay links, and a few radiotelephone communication stations; mobile cellular service is growing fast *international:* country code - 267; 2 international exchanges; digital microwave radio relay links to Namibia, Zambia, Zimbabwe, and South Africa; satellite earth station - 1 Intelsat (Indian Ocean)
Burkina Faso	*general assessment:* all services only fair *domestic:* microwave radio relay, open-wire, and radiotelephone communication stations *international:* country code - 226; satellite earth station - 1 Intelsat (Atlantic Ocean)
Burundi	*general assessment:* primitive system *domestic:* sparse system of open-wire, radiotelephone communications, and low-capacity microwave radio relay *international:* country code - 257; satellite earth station - 1 Intelsat (Indian Ocean)
Cameroon	*general assessment:* available only to business and government *domestic:* cable, microwave radio relay, and tropospheric scatter *international:* country code - 237; satellite earth stations - 2 Intelsat (Atlantic Ocean); fiber optic submarine cable (SAT-3/WASC) provides connectivity to Europe and Asia
Cape Verde	*general assessment:* effective system, extensive modernization from 1996-2000 following partial privatization in 1995 *domestic:* major service provider is Cabo Verde Telecom (CVT); fiber optic ring, completed in 2001, links all islands providing Internet access and ISDN services; cellular service introduced in 1998 *international:* country code - 238; 2 coaxial submarine cables; HF radiotelephone to Senegal and Guinea-Bissau; satellite earth station - 1 Intelsat (Atlantic Ocean)

Central African Rep.	*general assessment:* fair system *domestic:* network consists principally of microwave radio relay and low-capacity, low-powered radiotelephone communication *international:* country code - 236; satellite earth station - 1 Intelsat (Atlantic Ocean)
Chad	*general assessment:* primitive system *domestic:* fair system of radiotelephone communication stations *international:* country code - 235; satellite earth station - 1 Intelsat (Atlantic Ocean)
Comoros	*general assessment:* sparse system of microwave radio relay and HF radiotelephone communication stations *domestic:* HF radiotelephone communications and microwave radio relay *international:* country code - 269; HF radiotelephone communications to Madagascar and Reunion
Congo	*general assessment:* services barely adequate for government use; key exchanges are in Brazzaville, Pointe-Noire, and Loubomo; intercity lines frequently out of order *domestic:* primary network consists of microwave radio relay and coaxial cable *international:* country code - 242; satellite earth station - 1 Intelsat (Atlantic Ocean)
DR Congo	*general assessment:* poor *domestic:* barely adequate wire and microwave radio relay service in and between urban areas; domestic satellite system with 14 earth stations *international:* country code - 243; satellite earth station - 1 Intelsat (Atlantic Ocean)
Cote d'Ivoire	*general assessment:* well developed by African standards but operating well below capacity *domestic:* open-wire lines and microwave radio relay; 90% digitalized *international:* country code - 225; satellite earth stations - 2 Intelsat (1 Atlantic Ocean and 1 Indian Ocean); 2 submarine cables
Djibouti	*general assessment:* telephone facilities in the city of Djibouti are adequate, as are the microwave radio relay connections to outlying areas of the country *domestic:* microwave radio relay network *international:* country code - 253; submarine cable to Jiddah, Suez, Sicily, Marseille, Colombo, and Singapore; satellite earth stations - 1 Intelsat (Indian Ocean) and 1 Arabsat; Medarabtel regional microwave radio relay telephone network
Egypt	*general assessment:* large system; underwent extensive upgrading during 1990s and is reasonably modern; Internet access and cellular service are available *domestic:* principal centers at Alexandria, Cairo, Al Mansurah, Ismailia, Suez, and Tanta are connected by coaxial cable and microwave radio relay *international:* country code - 20; 5 coaxial submarine cables; satellite earth stations - 2 Intelsat (Atlantic Ocean and Indian Ocean), 1 Arabsat, and 1 Inmarsat;

	tropospheric scatter to Sudan; microwave radio relay to Israel; a participant in Medarabtel
Equatorial Guinea	*general assessment:* poor system with adequate government services *domestic:* NA *international:* country code - 240; international communications from Bata and Malabo to African and European countries; satellite earth station - 1 Intelsat (Indian Ocean)
Eritrea	*general assessment:* inadequate *domestic:* inadequate; most telephones are in Asmara; government is seeking international tenders to improve the system *international:* country code - 291; note - international connections exist
Ethiopia	*general assessment:* adequate for government use *domestic:* open-wire; microwave radio relay; radio communication in the HF, VHF, and UHF frequencies; 2 domestic satellites provide the national trunk service *international:* country code - 251; open-wire to Sudan and Djibouti; microwave radio relay to Kenya and Djibouti; satellite earth stations - 3 Intelsat (1 Atlantic Ocean and 2 Pacific Ocean)
Gabon	*general assessment:* adequate service by African standards and improving with the help of the growing mobile cell system *domestic:* adequate system of cable, microwave radio relay, tropospheric scatter, radiotelephone communication stations, and a domestic satellite system with 12 earth stations *international:* country code - 241; satellite earth stations - 3 Intelsat (Atlantic Ocean); fiber optic submarine cable (SAT-3/WASC) provides connectivity to Europe and Asia
Gambia	*general assessment:* adequate; a packet switched data network is available *domestic:* adequate network of microwave radio relay and open-wire *international:* country code - 220; microwave radio relay links to Senegal and Guinea-Bissau; satellite earth station - 1 Intelsat (Atlantic Ocean)
Ghana	*general assessment:* poor to fair system; Internet accessible; many rural communities not yet connected; expansion of services is underway *domestic:* primarily microwave radio relay; wireless local loop has been installed *international:* country code - 233; satellite earth stations - 4 Intelsat (Atlantic Ocean); microwave radio relay link to Panaftel system connects Ghana to its neighbors; fiber optic submarine cable (SAT-3/WASC) provides connectivity to Europe and Asia
Guinea	*general assessment:* poor to fair system of open-wire lines, small radiotelephone communication stations, and new microwave radio relay system *domestic:* microwave radio relay and radiotelephone communication

	international: country code - 224; satellite earth station - 1 Intelsat (Atlantic Ocean)
Guinea-Bissau	*general assessment:* small system *domestic:* combination of microwave radio relay, open-wire lines, radiotelephone, and cellular communications *international:* country code - 245
Kenya	*general assessment:* unreliable; little attempt to modernize except for service to business *domestic:* trunks are primarily microwave radio relay; business data commonly transferred by a very small aperture terminal (VSAT) system *international:* country code - 254; satellite earth stations - 4 Intelsat
Lesotho	*general assessment:* rudimentary system *domestic:* consists of a modest but growing number of landlines, a small microwave radio relay system, and a minor radiotelephone communication system; a cellular mobile telephone system is growing *international:* country code - 266; satellite earth station - 1 Intelsat (Atlantic Ocean)
Liberia	*general assessment:* the limited services available are found almost exclusively in the capital Monrovia *domestic:* fully automatic system with very low density of less than 1 fixed main line per 100 persons; limited wireless service available *international:* country code - 231; satellite earth station - 1 Intelsat (Atlantic Ocean)
Libya	*general assessment:* telecommunications system is being modernized; mobile cellular telephone system became operational in 1996 *domestic:* microwave radio relay, coaxial cable, cellular, tropospheric scatter, and a domestic satellite system with 14 earth stations *international:* country code - 218; satellite earth stations - 4 Intelsat, NA Arabsat, and NA Intersputnik; submarine cables to France and Italy; microwave radio relay to Tunisia and Egypt; tropospheric scatter to Greece; participant in Medarabtel
Madagascar	*general assessment:* system is above average for the region *domestic:* open-wire lines, coaxial cables, microwave radio relay, and tropospheric scatter links connect regions *international:* country code - 261; submarine cable to Bahrain; satellite earth stations - 1 Intelsat (Indian Ocean), 1 Intersputnik (Atlantic Ocean region)
Malawi	*general assessment:* NA *domestic:* system employs open-wire lines, microwave radio relay links, and radiotelephone communications stations *international:* country code - 265; satellite earth stations - 2 Intelsat (1 Indian Ocean, 1 Atlantic Ocean)

Mali	*general assessment:* domestic system unreliable but improving; provides only minimal service *domestic:* network consists of microwave radio relay, open-wire, and radiotelephone communications stations; expansion of microwave radio relay in progress *international:* country code - 223; satellite earth stations - 2 Intelsat (1 Atlantic Ocean, 1 Indian Ocean)
Mauritania	*general assessment:* limited system of cable and open-wire lines, minor microwave radio relay links, and radiotelephone communications stations (improvements being made) *domestic:* mostly cable and open-wire lines; a recently completed domestic satellite telecommunications system links Nouakchott with regional capitals *international:* country code - 222; satellite earth stations - 1 Intelsat (Atlantic Ocean), 2 Arabsat
Mauritius	*general assessment:* small system with good service *domestic:* primarily microwave radio relay trunk system *international:* country code - 230; satellite earth station - 1 Intelsat (Indian Ocean); new microwave link to Reunion; HF radiotelephone links to several countries; fiber optic submarine cable (SAT-3/WASC/SAFE) provides connectivity to Europe and Asia
Morocco	*general assessment:* modern system with all important capabilities; however, density is low with only 4 main lines available for each 100 persons *domestic:* good system composed of open-wire lines, cables, and microwave radio relay links; Internet available but expensive; principal switching centers are Casablanca and Rabat; national network nearly 100% digital using fiber-optic links; improved rural service employs microwave radio relay *international:* country code - 212; 7 submarine cables; satellite earth stations - 2 Intelsat (Atlantic Ocean) and 1 Arabsat; microwave radio relay to Gibraltar, Spain, and Western Sahara; coaxial cable and microwave radio relay to Algeria; participant in Medarabtel; fiber-optic cable link from Agadir to Algeria and Tunisia
Mozambique	*general assessment:* fair system but not available generally (extremely low density with less than 1 main line per 100 persons) *domestic:* the system consists of open-wire lines and trunk connection by microwave radio relay and tropospheric scatter *international:* country code - 258; satellite earth stations - 5 Intelsat (2 Atlantic Ocean and 3 Indian Ocean)
Namibia	*general assessment:* good system; about 6 telephones for each 100 persons *domestic:* good urban services; fair rural service; microwave radio relay links major towns; connections to other populated places are by open wire; 100% digital *international:* country code - 264; fiber-optic cable to South Africa, microwave radio relay link to Botswana, direct links to other neighboring countries; connected to

	Africa ONE and South African Far East (SAFE) submarine cables through South Africa; satellite earth stations - 4 Intelsat
Niger	*general assessment:* small system of wire, radio telephone communications, and microwave radio relay links concentrated in the southwestern area of Niger *domestic:* wire, radiotelephone communications, and microwave radio relay; domestic satellite system with 3 earth stations and 1 planned *international:* country code - 227; satellite earth stations - 2 Intelsat (1 Atlantic Ocean and 1 Indian Ocean)
Nigeria	*general assessment:* expansion and modernization of the fixed-line telephone network has been slow due to faltering efforts at privatization *domestic:* the addition of a second fixed-line provider in 2002 resulted in faster growth of this service; wireless telephony has grown rapidly, in part responding to the shortcomings of the fixed-line network; 4 wireless (GSM) service providers operate nationally; the combined growth resulted in a sharp increase in teledensity reported to be over 18% in March 2006 *international:* country code - 234; satellite earth stations - 3 Intelsat (2 Atlantic Ocean and 1 Indian Ocean); fiber optic submarine cable (SAT-3/WASC) provides connectivity to Europe and Asia
Rwanda	*general assessment:* telephone system primarily serves business and government *domestic:* the capital, Kigali, is connected to the centers of the provinces by microwave radio relay and, recently, by cellular telephone service; much of the network depends on wire and HF radiotelephone *international:* country code - 250; international connections employ microwave radio relay to neighboring countries and satellite communications to more distant countries; satellite earth stations - 1 Intelsat (Indian Ocean) in Kigali (includes telex and telefax service)
Sao Tome and Principe	*general assessment:* adequate facilities *domestic:* minimal system *international:* country code - 239; satellite earth station - 1 Intelsat (Atlantic Ocean)
Senegal	*general assessment:* good system *domestic:* above-average urban system; microwave radio relay, coaxial cable and fiber-optic cable in trunk system *international:* country code - 221; 4 submarine cables; satellite earth station - 1 Intelsat (Atlantic Ocean)
Seychelles	*general assessment:* effective system *domestic:* radiotelephone communications between islands in the archipelago *international:* country code - 248; direct radiotelephone communications with adjacent island countries and African coastal countries; satellite earth station - 1 Intelsat (Indian Ocean)

Sierra Leone	*general assessment:* marginal telephone and telegraph service *domestic:* the national microwave radio relay trunk system connects Freetown to Bo and Kenema *international:* country code - 232; satellite earth station - 1 Intelsat (Atlantic Ocean)
Somalia	*general assessment:* the public telecommunications system was almost completely destroyed or dismantled by the civil war factions; private wireless companies offer service in most major cities and charge the lowest international rates on the continent *domestic:* local cellular telephone systems have been established in Mogadishu and in several other population centers *international:* country code - 252; international connections are available from Mogadishu by satellite
South Africa	*general assessment:* the system is the best developed and most modern in Africa *domestic:* consists of carrier-equipped open-wire lines, coaxial cables, microwave radio relay links, fiber-optic cable, radiotelephone communication stations, and wireless local loops; key centers are Bloemfontein, Cape Town, Durban, Johannesburg, Port Elizabeth, and Pretoria *international:* country code - 27; 2 submarine cables; satellite earth stations - 3 Intelsat (1 Indian Ocean and 2 Atlantic Ocean)
Sudan	*general assessment:* generally adequate, modern facilities; teledensity is 45 main lines for each 100 persons *domestic:* NA *international:* country code - 34; 22 coaxial submarine cables; satellite earth stations - 2 Intelsat (1 Atlantic Ocean and 1 Indian Ocean), NA Eutelsat; tropospheric scatter to adjacent countries
Swaziland	*general assessment:* a somewhat modern but not an advanced system *domestic:* system consists of carrier-equipped, open-wire lines and low-capacity, microwave radio relay *international:* country code - 268; satellite earth station - 1 Intelsat (Atlantic Ocean)
Tanzania	*general assessment:* fair system operating below capacity and being modernized for better service; small aperture terminal (VSAT) system under construction *domestic:* trunk service provided by open-wire, microwave radio relay, tropospheric scatter, and fiber-optic cable; some links being made digital *international:* country code - 255; satellite earth stations - 2 Intelsat (1 Indian Ocean, 1 Atlantic Ocean)
Togo	*general assessment:* fair system based on a network of microwave radio relay routes supplemented by open-wire lines and a mobile cellular system *domestic:* microwave radio relay and open-wire lines for conventional system *international:* country code - 228; satellite earth stations - 1 Intelsat (Atlantic

	Ocean), 1 Symphonie
Tunisia	*general assessment:* above the African average and continuing to be upgraded; key centers are Sfax, Sousse, Bizerte, and Tunis; Internet access available *domestic:* trunk facilities consist of open-wire lines, coaxial cable, and microwave radio relay *international:* country code - 216; 5 submarine cables; satellite earth stations - 1 Intelsat (Atlantic Ocean) and 1 Arabsat; coaxial cable and microwave radio relay to Algeria and Libya; participant in Medarabtel; 2 international gateway digital switches
Uganda	*general assessment:* seriously inadequate; 2 cellular systems have been introduced, but a sharp increase in the number of main lines is essential; e-mail and Internet services are available *domestic:* intercity traffic by wire, microwave radio relay, and radiotelephone communication stations, fixed and mobile cellular systems for short-range traffic *international:* country code - 256; satellite earth stations - 1 Intelsat (Atlantic Ocean) and 1 Inmarsat; analog links to Kenya and Tanzania
Zambia	*general assessment:* facilities are aging but still among the best in Sub-Saharan Africa *domestic:* high-capacity microwave radio relay connects most larger towns and cities; several cellular telephone services in operation; Internet service is widely available; very small aperture terminal (VSAT) networks are operated by private firms *international:* country code - 260; satellite earth stations - 2 Intelsat (1 Indian Ocean and 1 Atlantic Ocean)
Zimbabwe	*general assessment:* system was once one of the best in Africa, but now suffers from poor maintenance; more than 100,000 outstanding requests for connection despite an equally large number of installed but unused main lines *domestic:* consists of microwave radio relay links, open-wire lines, radiotelephone communication stations, fixed wireless local loop installations, and a substantial mobile cellular network; Internet connection is available in Harare and planned for all major towns and for some of the smaller ones *international:* country code - 263; satellite earth stations - 2 Intelsat; 2 international digital gateway exchanges (in Harare and Gweru)

Table B- 3 Telephone system in Africa

B.4 Telecommunication regulators and operators in Africa

The following table shows the responsible ministry of the telecommunications, the telecommunication regulator and telecommunication operator of the African countries.

Country	Responsible ministry	Telecommunication regulator	Telecommunication operator
Algeria	Ministry of Post and Telecommunications	Ministry of Post and Telecommunications	Ministry of Post and Telecommunications
Angola	Ministry of Post and Telecommunications (P&T)	Angola Telecom	Angola Telecom (Empressa Publica de Telecommunicatoes de Angola)
Benin	The Office des postes et télécommunications (OPT)	The Office des postes et télécommunications (OPT)	The Office des postes et télécommunications (OPT)
Botswana	The Ministry of Works, Transport and Communications	Botswana Telecommunications Authority (BTA)	Botswana Telecommunications Corporation (BTC)
Burkina Faso	Ministère de la communication et de la culture	Office national des Télécommunications (ONATEL)	Office national des Télécommunications (ONATEL)
Burundi	The Office National des Télécommunications (Onatel)	The Agence de Régulation et de Contrôle des Télécommunications (ARCT)	The Office National des Télécommunications (Onatel)
Cameroon	Ministère des Postes et Télécommunications (MPT)	Ministère des Postes et Télécommunications (MPT)	Ministère des Postes et Télécommunications (MPT)
Cape Verde	Ministère des Postes	Directorate of Communications	Cabo Verde Telecom
Central African Rep.	Société Centrafricaine des Télécommunications (SOCATEL)	Inspecteur Central des Télécommunications	Société Centrafricaine des Télécommunications (SOCATEL)
Chad	The Ministère des Postes et Télécommunications	Société des Télécommunications Internationales du Tchad (TIT)	The Ministère des Postes et Télécommunications
Comoros	The Société Nationale des Postes et Télécommunications	The Office de Postes et Télécommunications	The Société Nationale des Postes et Télécommunications

Congo	The Office National des Postes et Télécommunications (ONPT)	The Office National des Postes et Télécommunications (ONPT)	The Office National des Postes et Télécommunications (ONPT)
DR Congo	Office Congolais des Postes et des Télécommunications (OCPT)	The Ministère des Postes et Télécommunications	The Office Congolais des Postes et des Télécommunications (OCPT)
Cote d'Ivoire	Conseil des Télécommunications de Côte d'Ivoire (CTCI)	Agence des Télécommunications de Côte d'Ivoire (ATCI)	Côte d'Ivoire Telecom (CI-Telecom)
Djibouti	Ministry of Transports and Telecommunications	Ministry of Transports and Telecommunications	Office des Postes et Télécommunications (OPT)
Egypt	Ministry of Transport and Telecommunications	The Telecommunication Regulatory Board	Telecom Egypt
Equatorial Guinea	Sociedad Anonima de Telecomunicaciones de la Republica de Guinea Ecuatorial	Directorate of Posts and Telecommunications	Sociedad Anonima de Telecomunicaciones de la Republica de Guinea Ecuatorial (GETESA)
Eritrea	Ministry of Transport and Communications	Communications Department	Telecommunications Service of Eritrea
Ethiopia		Ethiopian Telecommunications Agency (ETA)	Ethiopian Telecommunications Corporation (ETC)
Gabon	Ministère de la Défense Nationale, de la Sécurité et de l'Immigration, chargé des Postes et des Télécommunications	Office de postes et télécommunications (OPT)	Office de postes et télécommunication (OPT)
Gambia	Telecommunications Department and Cables and Wireless PLC	Gamtel	Gamtel
Ghana	Ghana Posts and Telecommunications Corporation (GPTC)	National Communications Authority (NCA)	Ghana Telecom
Guinea	Ministère des Postes et Télécommunications	Direction Nationale des Postes et des Télécommunications (DNPT)	Société des Télécommunications de Guinée (Sotelgui)

Guinea-Bissau	Ministry of Transport and Telecommunications (MTT)	Portugal Telecom Internacional (PTI)	Guine Telecom
Kenya	Kenya Posts and Telecommunications Corporation (KPTC)	Communications Commission of Kenya (CCK)	Kenya Posts and Telecommunications Corporation (KPTC)
Lesotho	Ministry of Works and Communications	Ministry of Works and Communications	Lesotho Telecommunications Corporation (LTC)
Liberia	Ministry of Posts and Telecommunications	Ministry of Posts and Telecommunications	Liberia Telecommunications Corporation (LTC)
Libya	General Posts and Telecommunications Company (GPTC)	General Posts and Telecommunications Company (GPTC)	General Posts and Telecommunications Company (GPTC)
Madagascar	Ministry of Posts and Telecommunications	Office Malgache des Etudes et de Régulation des Télécommunications (OMERT)	Société Telecom Malagasy SA
Malawi	Malawi Posts and Telecommunications Company (MPTC)	Malawi Communications Regulatory Authority (MACRA)	Malawi Posts and Telecommunications Company (MPTC)
Mali	Ministère de la Communication	Société des télécommunications du Mali (SOTELMA)	Société des télécommunications du Mali (SOTELMA)
Mauritania	Office des Postes et Telecommunications (OPT)	The Government of Mauritania	Office des Postes et Telecommunications (OPT)
Mauritius	Ministry of Telecommunications and Information Technology	Telecommunication Authority	Mauritius Telecom
Morocco	Office National des Postes et des Télécommunications (ONPT)	Agence Nationale de Réglementation des Télécommunications (ANRT)	Itissalat Al Maghrib (IAM)
Mozambique	Instituto Nacional das Comunicaçoes de Moçambique (INCM)	Ministry of Transport and Communications (MTC)	Telecomunicações de Moçambique (TDM)
Namibia	Posts and Telecom Holdings	Namibia Communications Commission	Telecom Namibia

Niger	Ministère de la Communication et de la Culture	Direction de la Réglementation des Télécommunications (DRPT)	Société Nigérienne des Télécommunications (SONITEL)
Nigeria	Nigerian Telecommunications Limited (NITEL)	Nigerian Communications Commission (NCC)	Nigerian Telecommunications Limited (NITEL)
Rwanda	Ministry of Transport and Communications	Ministry of Transport and Communications	Société Rwandaise des Télécommunications, RwandaTel
Sao Tome and Principe	Portugal Telecommunications International (PTI)	Ministerio do Equipamento Social e Ambiente	The Companhia Santomense de Telecomunicaçoes (CST)
Senegal	Senegalese Office des Postes et Télécommunications	Direction des Etudes et de la Réglementation des Postes et des Télécommunications	Société Nationale des Télécommunications (SONATEL)
Seychelles	Ministry of Information Technology and Communications (MITC)	Ministry of Information Technology and Communications (MITC)	Cable and Wireless Plc.
Sierra Leone	Ministry of Transport, Communication and the Environment	Ministry of Transport, Communication and the Environment	Sierratel
Somalia			Somalia Telecom Ltd.
South Africa	The Ministry for Posts, Telecommunications and Broadcasting	South Africa Telecommunication Regulatory Authority (SATRA)	Telkom South Africa (Ltd.)
Sudan	Ministry of Roads and Communications	National Telecommunications Council (NTC)	Sudan Telecommunications Company (Sudatel)
Swaziland	Swaziland Posts and Telecommunications Corporation (STPC)	Swaziland Posts and Telecommunications Corporation (STPC)	Swaziland Posts and Telecommunications Corporation (STPC)
Tanzania	Tanzania Posts and Telecommunications Corporation	Tanzania Communications Commission (TCC)	Tanzania Telecommunications Company Limited (TTC)
Togo	Ministère des Mines, de l'Equipement, des Transports et du Logement	Cellule de Coordination de la Réforme des P&Ts	Togo Telecom

Tunisia	Ministère des Communications	Ministère des Communications	Office National des Télécommunications
Uganda	Uganda Posts and Telecommunications Corporation (UPTC)	Uganda Communications Commission (UCC)	Uganda Telecommunications Ltd.
Zambia	Zambia Postal Services Corporation	Zambia Communications Authority (ZCA)	ZAMTEL
Zimbabwe	Zimbabwe Posts and Telecommunications Corporation (PTC)	Zimbabwe Posts and Telecommunications Corporation (PTC)	Zimbabwe Posts and Telecommunications Corporation (PTC)

Table B- 4 Telecommunication regulators and operators in Africa

B.5 African broadcast operators

The following table shows the main suppliers of the internet connection and the broadcast operators (RD for Radio, TV for Television).

Country	**ISP**	**Broadcast Operator**
Algeria	CERIST (www.cerist.dz)	RD: Radio Algérienne TV: Entreprise Nationale de Télévision
Angola	EBOnet (www.ebonet.com)	TV: Televisao Publico de Angola
Benin	Office des Postes et Télécommunications (www.opt.bj)	RD & TV: The Office de Radiodiffusion et Télévision du Bénin
Botswana	Info Botswana Internet Services (www.info.bw)	RD & TV: Department of Information and Broadcasting
Burkina Faso	ONATEL (www.onatel.bf)	RD: Radiodiffusion Nationale du Burkina TV: Télévision Nationale du Burkina
Burundi	CBINET (cni.cbinf.com)	RD & TV: TTITvision Nationale du Burundi

Cameroon	CamNet (www.camnet.cm)	RD & TV: Cameroun Radio Television
Cape Verde	Instituto Superior de Engenharia e Ciencias de Mar	RD: RNCV – Radio Nacional de Cabo Verde TV: TCNV – Televisao Nacional de Cabo Verde
Central African Rep.	Socatel (socatel.intnet.cf)	
Chad	Société des Télécommunications Internationales du Tchad (TIT)	RD: Radiodiffusion Nationale Tchadienne TV: Téléchad
Comoros	ComNet (www.snpt.km)	RD: Radio Comoro
Congo		RD: TTITvision Congolaise
DR Congo	InterConnect (www.ic.cd)	RD & TV: Radio Television Nationale Congolaise (RTNC)
Cote d'Ivoire	AfricaOnline (www.africaonline.co.ci)	
Djibouti	Société des Télécommunications Internationales de Djibouti (STID)	
Egypt	RITSEC (www.ritsce.com.eg)	RD & TV: The Egyptian Radio and Television Union (ERTU)
Equatorial Guinea	GETESA **(**www.intnet.gq**)**	RD: Radio Nacional de Guinea Equatorial TV: Television Nacional
Eritrea		RD: Radio Asmarino
Ethiopia	Ethiopian Telecommunications Corporation (ETC)	
Gabon	Office nationale de postes et télécomunication (www.inet.ga)	RD: La Voix de la Rénovation TV: Radiodiffusion-Télévision Gabonaise
Gambia	Gamtel (Gambia Telecommunications Company) (www.gamtel.gm)	RD & TV: Gambia Radio and Television Services (GRTS)

Ghana	Network Computer Systems (www.ghana.com.gh)	RD: Radio One TV: GBC
Guinea	MiriNet (www.mirinet.net.gn)	RD & TV: Radiodiffusion-Télévision Guinéenne
Guinea-Bissau	Guine Telecom (sol.gtelecom.gw)	RD & TV: Radio Televisao de Guine Bissau
Kenya	Africa Online Kenya (www.africaonline.co.ke)	RD: Kenya Broadcasting Corporation TV: Kenya Television Network
Lesotho		TV: MultiChoice
Liberia		RD & TV: Liberian Broadcasting System
Libya	National Corporation for Information and Documentation (www.nida.org.ly)	RD: Libyan Jamahiriya Broadcasting TV: Libya Television
Madagascar	Data Telecom Services (www.dts.mg)	RD & TV: Radio Télévision Malagasy
Malawi	MalawiNet **(**www.malawi.net)	RD: Chichewa
Mali	SOTELMA (www.sotelma.ml)	RD & TV: Radiodiffusion-Télévision Malienne
Mauritania	Office des Postes et Telecommunications (www.opt.mr)	RD: Radio Mauritanie TV: TV de Mauritanie
Mauritius	Telecom Plus Ltd. (www.intnet.mu)	RD & TV: Mauritius Broadcasting Corporation
Morocco	IPC (www.ipc.net.ma)	RD & TV: Radiodiffusion Television Marocaine
Mozambique	Virtual Connection (www.virconn.com)	RD: Radio Moçambique TV: Televisao de Moçambique
Namibia	UUNET Internet Africa Namibia	National Broadcasting Corporation

	(www.uunet.com.na)	
Niger	Société Nigérienne des Télécommunications (www.intnet.ne)	RD: Voix du Sahel TV: Tele Sahel
Nigeria	LinkServe (www.linkserve.com.ng)	RD: Radio Nigeria TV: Television Broadcasting: Nigerian Television Authority
Rwanda	RwandaTel (www.rwanda1.com)	RD: Radiodiffusion de la République Rwandaise
Sao Tome and Principe		RD: Rádio Nacional de Sao Tomé e Princípe TV: Televisao de Sao Tomé e Princípe
Senegal	Telecom-Plus (www.telecom-plus.sn)	RD & TV: RadioDiffusion Télévision Sénégalaise
Seychelles	Atlas (www.seychelles.net)	RD & TV: Seychelles Broadcasting Corporation
Sierra Leone	Sierratel (www.sierratel.sl)	RD & TV: Sierra Leone Broadcasting Service
Somalia		RD: Radio Hargeisa
South Africa	UUNET Internet Africa (www.iafrica.com)	RD: SABC Radio TV: South African Broadcasting Corporation
Sudan	SudaNet (www.sudanet.net)	RD: Radio Omdurman TV: Sudan Television
Swaziland	Swaziland Posts and Telecommunications Corporation (www.sptc.co.sz)	RD: Swaziland Broadcast Service TV: Swaziland Television Authority
Tanzania	CyberTwiga (home.twiga.com)	RD & TV: Independent Television and Radio One Ltd.

Togo	Centre d'Assistance de Formation et d'Etude Informatique (www.cafe.tg)	RD: Radiodiffusion Togolaise TV: Television Togolaise
Tunisia	Planet Tunisie (www.planet.tn)	RD & TV: l'Etablissement de la Radio-diffusion Télévision Tunisienne
Uganda	Uganda OnLine (www.uol.co.ug)	RD & TV: Uganda Ministry of Information
Zambia	Zamnet (www.zamnet.zm)	RD & TV: *Zambian National Broadcasting Corporation*
Zimbabwe	Data Control (www.harare.iafrica.com)	RD & TV: Zimbabwe Broadcasting Corporation

Table B- 5 African broadcast operators

B.6 Main internet prices on the African market

The following table shows the main offers that can be found on the African market (in particular in South Africa).

Service	Speed	Capped	IP	Installation price	Monthly price
Analog Dial-up	56 Kbps	-	private	-	R70
ISDN Dial-up	64 Kbps	-	private	-	R70
ISDN Dial-up	128 Kbps	-	private	-	R140
ADSL	512 Kbps	3 GB	private	R490	R275
ADSL	512 Kbps	7 GB	private	R490	R495
ADSL	512 Kbps	10 GB	private	R490	R695
ADSL	512 Kbps	NO	private	R490	R1699
Wireless	384 Kbps	200 MB	public	R2850	R99

Wireless	512 Kbps	500 MB	private	R2850	R169
Wireless	64 Kbps	NO (no P2P)	private	R2850	R198
Wireless	512 Kbps	1000 MB	public	R2850	R199
Wireless	1024 Kbps	2000 MB	public	R2850	R299
Wireless	128 Kbps	NO (no P2P)	private	R2850	R398
Wireless	512 Kbps	4 GB	private	R2850	R400
Wireless	2048 Kbps	3000 MB	public	R2850	R499
Wireless	128 Kbps	NO	private	R2850	R550
Wireless	256 Kbps	NO (no P2P)	private	R2850	R598
Wireless	512 Kbps	6.5 GB	private	R2850	R650
Wireless	2048 Kbps	3 GB	private	R2850	R650
Wireless	512 Kbps	9.5 GB	private	R2850	R950
Wireless	768 Kbps	NO	private	R2850	R1250
Wireless	1024 Kbps	NO	private	R2850	R1550
Wireless	512 Kbps	NO	public	R2850	R1950
Wireless	1024 Kbps	NO	public	R2850	R3950
Satellite	64 Kbps	NO	public	-	R295
Satellite	192 Kbps	NO	public	-	R495
Satellite	384 Kbps	NO	public	-	R795
Satellite	512 Kbps	NO	public	-	R950

Satellite	1024 Kbps	NO	public	-	R3078
Satellite	4096 Kbps	NO	public	-	R5130
Fiber	512 Kbps	NO	public	-	R2850
Fiber	1024 Kbps	NO	public	-	R5700

Table B- 6 Main internet prices on the African market

B.7 Electric Power in Africa

The particular conditions of technological and infrastructural backwardness of Africa, along with the temperament and the spirit of brotherhood of many African countries, have brought to the formation of some important organizations that comprehend many states members, united in their common mission.

[A08] The UPDEA is the Union of Producers, Transporters and Distributors of Electric Power in Africa. UPDEA was established in May 1970 with its headquarters in Abidjan, Côte d'Ivoire. The union was created with the aim of promoting development and integration of the African power systems through the interconnection of networks, the exchanges of experiences and know-how as well as the pooling of energy resources in a win-win approach for all members. Since 2002, UPDEA has adopted a new vision according to which, UPDEA must henceforth be the primary catalyst of the realisation of access to electricity for all the peoples of Africa. Given that the energy resources are not equally spread throughout the continent, UPDEA committed itself to promote or initiate the setting up of sub regional power pools where necessary, in close relationships with Regional Economic Communities. The active members are listed below:

1. SONELGAZ (ALGERIA)
2. EDEL (ANGOLA)
3. ENE(ANGOLA)
4. SBEE (BENIN)
5. BPC (BOTSWANA)
6. SONABEL (BURKINA FASO)
7. REGIDESO {BURUNDI)
8. AES-SONEL (CAMEROON)
9. STEE (CHAD)
10. SNE (CONGO)
11. CIE (COTE D'IVOIRE)

12 SOGEPE (COTE D'IVOIRE)
13 SOPIE (COTE D'IVOIRE)
14 DJIBELEC (DJIBOUTI)
15 EEHC (EGYPT)
16 EEPCO (ETHIOPIA)
17 SEEG (GABON)
18 NAWEC (GAMBIA)
19 ECG (GHANA)
20 VRA (GHANA)
21 EDG (GUINEA CONAKRY)
22 EAGB (GUINEA BISSAU)
23 KenGen (KENYA)
24 KPLC (KENYA)
25 LEC (LESOTHO)
26 LEC (LIBERIA)
27 GECOL (LYBIA)
28 JIRAMA (MADAGASCAR)
29 ESCOM (MALAWI)
30 EDM (MALI)
31 SOMELEC (MAURITANIA)
32 DRSC (MOROCCO)
33 EDM (MOZAMBIQUE)
34 NAMPOWER (NAMIBIA)
35 NIGELEC (NIGER)
36 SONICHAR (NIGER)
37 PHCN (NIGERIA)
38 SOGEM (OMVS)
39 ENERCA (C.A.R.)
40 SINELAC (DRC/RW/BUR)
41 SNEL (D.R CONGO)
42 ELECTROGAZ (RWANDA)
43 SENELEC (SENEGAL)
44 GTI (SENEGAL)
45 ESKOM (SOUTH AFRICA)
46 NEC (SUDAN)
47 TOGO ELECTRICITE (TOGO)
48 CEB (TOGO/BENIN)
49 STEG (TUNISIA)
50 UEGCL (UGANDA)
51 ZESA (ZIMBABWE)
52 ZESCO (ZAMBIA)

Figure B-1 UPDEA Active Members

Now, Africa has been divided in subregional power pools (as shown in figure):

Figure B-2 African Sub-Regional Power Pools

- COMELEC (in the Northern Africa)
- WAPP (in the West Africa)
- CAPP (in the Central Africa)
- EAPP (in the Eastern Africa)
- SAPP (in the Southern Africa)

[A09] Electric generating capacity in Africa in 1997 was concentrated in two regions: North and Southern Africa. Combined, those two regions alone accounted for 82% of total power generating capacity in Africa. The Democratic Republic of Congo (Central), Kenya (East), and Nigeria (West) are the leaders in power generating capacity for Africa's other regions.

COMELEC (Maghreb Electricity Committee)

[A10] On the Maghreb side (Morocco, Algeria, Tunisia, Lybia and Mauritania), a long tradition of interconnections exists between the companies of electricity in the countries of the region. Three connections are established between Morocco and Algeria, 5 between Algeria and Tunisia and 2 between Libya and Tunisia. Otherwise, an electric network joining Egypt, Libya, Tunisia, Algeria and Morocco (Etalem), (a link of 500 kilovolts) will be operational from 2015. However, interconnections between Algeria and Spain, on the one hand, and Tunisia and Italy, on the other hand, are under establishment. The will to create a maghrebin market of electricity goes back up to 1991. The Committee from the Maghreb of electricity (Comelec), whose presidency is assured currently by Tunisia, decided, under the aegis of the ministries of the Maghreb charged of the energy, to lead a survey aiming to identify the conditions of institution of this market. In comparison of the European countries, the consumption of electricity of the three countries of Maghreb (Tunisia, Algeria and Morocco) remains modest. It represents 17% of the total consumption of Italy and 25% of the one of Spain. In the goal to reinforce the partnership euro-maghrebin about the subject, it is not necessary to limit itself to transpose to the level of Maghreb an European legislation. It would be more appropriate to conceive rules adapted to the size of the market and the stage of development of the countries of the Maghreb.

In the North African region there are relatively few projects in progress: [A09]

- The Democratic Republic of Congo is planning to develop projects to expand the Inga hydroelectric facility located on the Congo River. The 2,000-MW Inga II plant and the 40,000-MW Grand Inga facility would be utilized primarily for power exports. The combined capacity of these two projects is almost as large as Southern Africa's current installed capacity.
- Three firms - EEF (Switzerland), Infra-Consult (Germany) and Medis (Belgium) - have signed an agreement to rehabilitate the Democratic Republic of Congo's Societe Nationale d'Electricité (SNEL) electricity system. The rehabilitation will include work on generation facilities in Kinshasa, as well as production and distribution in North and South Kivu provinces.
- Equatorial Guinea is proposing to replace an existing diesel plant on the island of Bioko with a 6-MW to 8-MW thermal power plant. The station would utilize gas, which is currently flared, from the Alba field.

<u>SAPP (Southern African Power Pool)</u>

The Southern African Power Pool was founded in 1995 and involve the following countries: South Africa, Namibia, Botswana, Zambia, Angola, Zimbabwe, Mozambique, Malawi, Lesotho, D.R Congo, Tanzania and Swaziland.

[A11] The SAPP was created with the primary aim to provide reliable and economical electricity supply to the consumers of each member, consistent with the reasonable utilisation of natural resources and the effect on the environment. Co-operation in the electricity sector is not a new phenomenon in the Southern African region. All utilities participating in SAPP have equal rights and obligations, and have agreed to act in solidarity without taking advantage of one another. Members have undertaken to share information and knowledge, be politically neutral, develop common planning and operating criteria and procedures and to accept wheeling on behalf of other members when this is technically feasible.

The image below shows the connections in the Southern African Region.

Figure B-3 Connections in the Southern African Region

The quantity of electric energy produced in the Sub-African region is grown notably in the last 5 years, however less than the request is grown. For this motive the volumes of energy traded is decreased, year after year, as shown in figure:

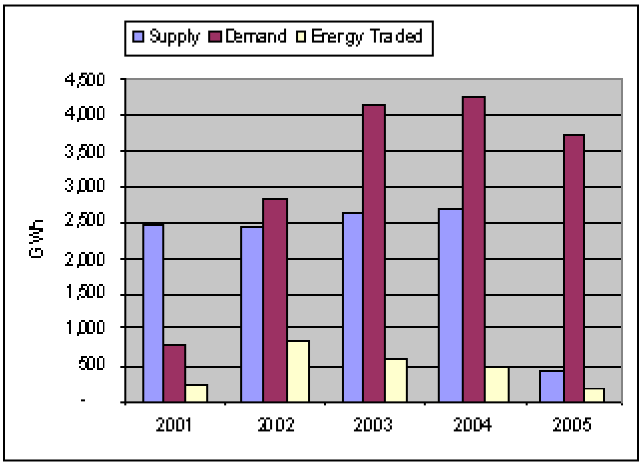

Figure B-4 Energy trade summary from year beginning 2001 to 2005

On the other hand, the average price of the electricity is exponentially grown, as it can be noticed by the underlying graph:

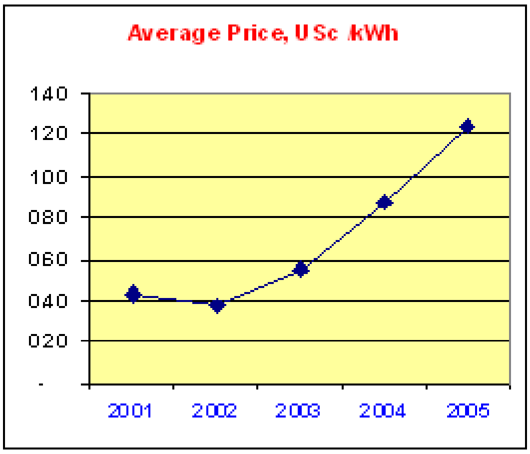

Figure B-5 STEM annual average prices for year beginning 2001 to 2005

In the next years they are anticipated some important projects: [A09]

- Angola's generation capacity will nearly double when the 520-MW Capanda hydroelectric facility is completed. Scheduled completion of Capanda is for the end of

1999, and Angola's state-owned utility, Empresa Nacional de Electricidade (ENE), is planning to begin construction of an oil-fired power plant in the city of Lubango.

- The Lesotho Highlands Water Project, which involves the construction of dams, tunnels and pipelines, is designed to include a total of 274 MW of hydroelectric generating capacity. The first phase of the 80-MW Muela hydro facility came online in 1999.
- The Compagnie Thermique de Belle Vue (CTBV), a joint-venture composed of Harel Freres (51%) of Mauritius, France's Cidec (27%), the Sugar Investment Trust of Mauritius (14%) and the State Investment Fund (8%), will build a 70-MW IPP facility north of the Mauritian capital of Port Louis. The CTBV plant, which is expected to become operational in 2000, will utilize bagasse (biomass refuse from the processing of sugar cane) as its primary fuel.
- Electricidade de Mocambique (EDM), Mozambique's state utility, and Hidroelectrica de Cahora Bassa (HCB), a joint-venture between Portugal and EDM, have restored the electricity interconnection from the Cahora Bassa dam with South Africa, by replacing over 2,000 pylons that were damaged during the civil war. Cahora Bassa, with a nominal capacity of 2,000 MW, also supplies power to neighboring Zimbabwe. Plans for a second dam on the Zambezi River, with capacity of 2,000-2,500 MW, are being considered.
- The Zambia Electricity Supply Corporation (ZESCO) plans to rehabilitate the generation facilities at Victoria Falls. The work is expected to restore the facility to its full generating capacity of 108 MW. ZESCO also began rehabilitation work on its main generation facility, the Kafue Gorge hydroelectric station, in 1999.
- National Power of the United Kingdom, in conjunction with the Zimbabwe Electricity Supply Authority (ZESA), has plans to develop a 1,400-MW, coal-fired plant. The IPP facility, Gowke North, could supply approximately one-third of Zimbabwe's electricity requirements. National Power is to operate the facility, and ZESA is to purchase the power produced.

The South African region is, as said, that more developed by the infrastructural point of view. This, thanks to the government investments, but also thanks to the electric companies of the region, listed below:

Country	Electric Company	Contact
Angola	Empresa National de Electricidade	Website: www.ene.co.ao
Botswana	Botswana Power Cooperation	Website: www.bpc.bw
DR Congo	Société National d'Electricité	e-mail: sneldg@ic.cd
Lesotho	Lesotho Electricity Corporation	Website: www.lec.co.ls
Malawi	Electricity Supply Commission of Malawi	Website: www.escommw.com
Mozambique	Electricidade de Mozambique	Website: www.edm.co.mz
Namibia	Nam Power	Website: www.nampower.com.na
South Africa	Eskom	Website: www.eskom.co.za
Swaziland	Swaziland Electricity Board	Website: www.seb.co.sz
Tanzania	Tanzania Electric Supply Company Limited	
Zambia	Zambia Electricity Supply Corporation Limited	Website: www.zesco.co.zm
Zimbabwe	Zimbabwe Electricity Supply Authority	Website: www.zesa.co.zw

Table B- 7 SAPP Electric Companies

Eskom is without doubt the greatest electric company of the region, as well as of the whole Africa (Eskom Enterprises is among the top seven utilities in the world in terms of generation capacity, and among the top nine in terms of sales).

With its 359,854 km of power lines, Eskom sell 218,120 GWh to 3,963,164 customers. The company has a nominal capacity of 42,618 MW and a net maximum capacity of 37,761 MW and is present in Uganda, Nigeria and Mali (in addition to South Africa).

[A12] Eskom was converted from a statutory body into a public company, Eskom Holdings Limited, with effect from 1 July 2002. The two-tier governance structure of the Electricity Council and the Management Board was replaced by a Board of Directors.

The Government of the Republic of South Africa is the sole shareholder of Eskom. The shareholder representative is the Minister of Public Enterprises.

Eskom has reached its position of supremacy, also thanks to the use of nuclear energy:

[A13] South Africa has two nuclear reactors generating 6% of its electricity. Its first commercial nuclear power reactor began operating in 1984 and now, government commitment to the future of nuclear energy is strong.

Eskom supplies about 95% of South Africa's electricity and more than 60% of Africa's. By 2008 regional electricity demand is expected to exceed supply capacity, and SA power exports are already being curtailed.

In the following Southern Africa grid map, it can be seen the Eskom's electric distribution network and to notice the nuclear plant situated in the south of the country, in Koeberg.

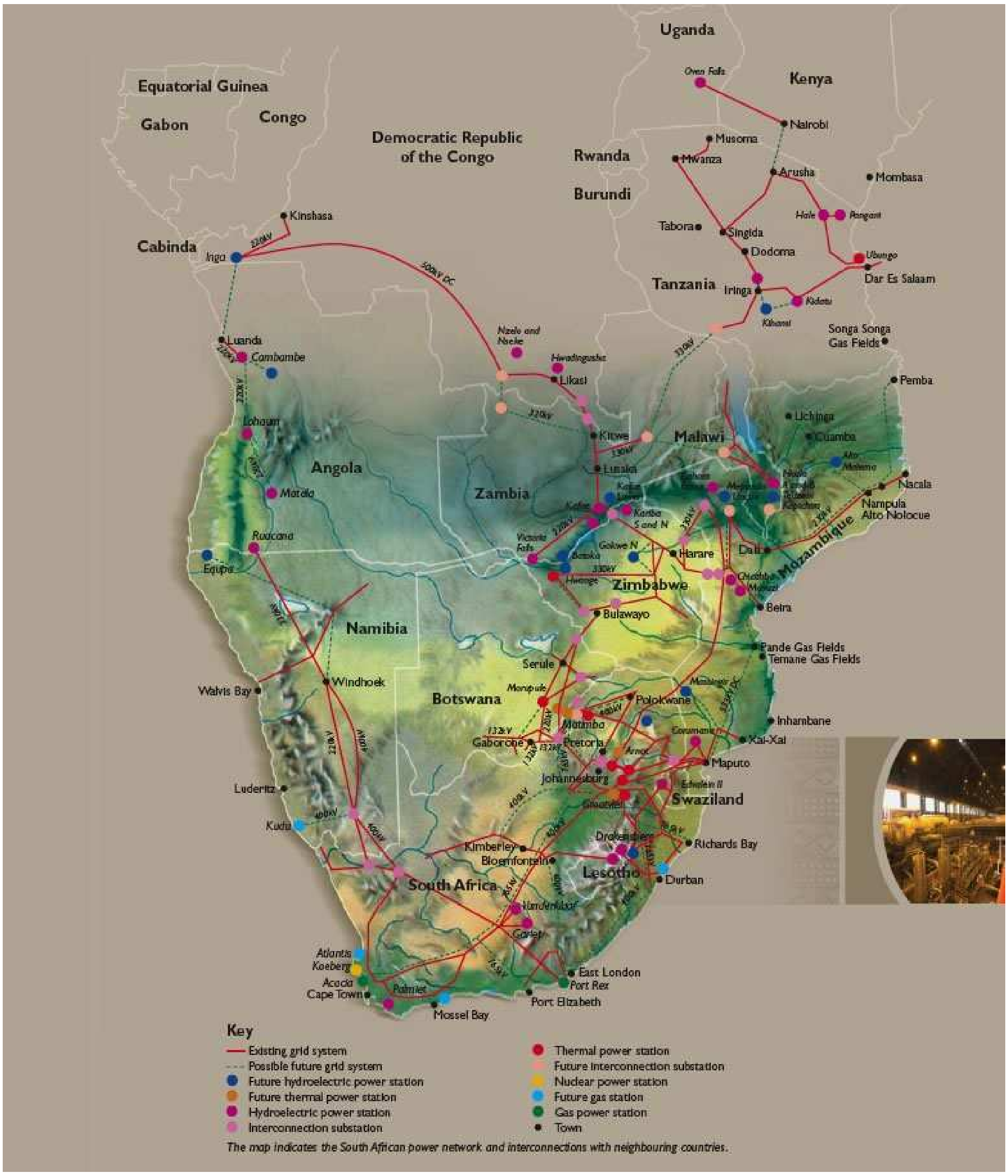

Figure B-6 Southern Africa grid map

[A13] The Koeberg plant was built by Framatome and commissioned in 1984-85. It is owned and operated by Eskom and has twin 900 MWe pressurised water reactors (PWR) the same as those providing most of France's electricity. Early in 2007 the Eskom board approved a plan to boost output to 80 GWe by 2025, including construction of 20 GWe of new nuclear capacity so that nuclear contribution to power would rise from 6% to more than 25% and coal's contribution would fall from 87% now to below 70%.

Since 1993 Eskom in collaboration with others has been developing the Pebble Bed Modular Reactor (PBMR) and is ready to build the lead unit of this design. Construction cost (when in clusters of eight units) is expected to be modest and generating cost competitive. After the demonstration pilot plant is in operation, the South African government has said that it wants to order 24 or more units totalling at least 4000 MWe. One quarter of South Africa's electricity is envisaged from PBMRs. A shareholders' agreement for the PBMR project was struck in 2005 among Eskom (41%), the South African Industrial Development Corporation (14%), the SA government (30%) and the US company Westinghouse (15%), now owned largely by Toshiba. However in August 2006 the agreement expired due to a delay in a licensing issue, and PBMR Ltd reverted 100% to Eskom.

In the rest of the Southern Africa, the situation is not so rosy. Nevertheless in the totality, this region is the more served. Namibia for example, has Africa’s third highest electrification level. At present, Namibia aims to develop renewable energy, particularly wind power, and increase rural electrification, which presently stands at only 30 percent compared with 85 percent of urban households being electrified.

Unfortunately, many African countries need a lot of natural resources to produce their electricity: first of all coal but also oil, diesel power stations and water (hydro stations).

<u>WAPP (West Africa Power Pool)</u>

[A14] The WAPP Organization has been created to integrate the national power system operations into a unified regional electricity market, with the expectation that such mechanism would, over the medium to long-term, assure the citizens of ECOWAS Member States a stable and reliable electricity supply at affordable costs.

The West African Power Pool was guided by a Steering Committee comprising Energy Ministers of ECOWAS Member States, supported by a Project Implementation Committee, comprising Managing Directors of Members States utilities and Technical and Institutional Working Groups.

The principal objectives are:

- Formalise an official and extended collaboration in the region in order to develop power generation and transmission facilities, thus enhancing power supply and strengthening power security within the sub-region.
- Minimise operating cost of networks.
- Increase investments needed for power grid expansion in the region, with emphasis on the implementation of cross-border projects.
- Create an attractive environment for investments in order to facilitate the funding of power generation and transmission facilities.
- Create a common operating standards and rules in the sector.

Countries involved in the WAPP are: Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea Bisau, Guinea, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo.

The most important electric company are listed below:

Country	Electric Company	Contact
Benin	Société Beninoise d'Energie Electrique (SBEE)	Website: www.sbeebenin.com
Burkina Faso	Société Nationale d'Electricité du Burkina (SONABEL)	Website: www.sonabel.bf
Cote d'Ivoire	Société d'Opération Ivoirienne d'Electricité (SOPIE)	Website: www.sopie.ci
Gambia	National Water and Electricity Company (NAWEC)	
Ghana	Volta River Authorithy (VRA)	Website: www.vra.com
Guinea	Electricité de Guinée (EDG)	
Liberia	Liberian Electricity Corporation (LEC)	

Mali	Energie du Mali (EDM)	Website: www.cefib.com
Nigeria	Power Holding Company of Nigeria (PHCN)	Website: www.nepanigeria.org
Senegal	Société d'Electricité du Sénégal (SENELEC)	Website: www.senelec.sn
Sierra Leone	National Power Authority (NPA)	

Table B- 8 WAPP Electric Companies

The Western Africa is not developed as the Southern Africa, but it is perhaps that that has more desire to develop itself. In this optics numerous projects are anticipated and many alternative technologies are in study. The most important projects are the followings: [A09]

- U.S.-based firms Enron and Abacan are negotiating with the government of Benin to develop, construct and operate an 80-MW power generation facility.
- Cote d'Ivoire’s CIPREL (Compagnie Ivoirienne de Production d'Electricité) project was one of the first IPP projects undertaken in sub-Saharan Africa. The plant, which is gas fired with a generating capacity of 210 MW, is a joint-development of the French firms EDF and Saur - Bouygues (SAUR). EDF and SAUR are the joint-owners of the Compagnie Electricité Ivoirienne (CIE), the former state utility, which was privatised in 1990.
- The Cinergy consortium has won a 23-year BOOT concession to build a thermal power plant at Azito outside of Abidjan, Cote d’Ivoire Cinergy's plan calls for a $223-million, 420-MW gas-fired facility. The first phase of the Azito power plant was inaugurated on January 23, 1999. A second 144-MW gas turbine is scheduled to begin operations in January 2000. A steam-powered turbine will be added to boost the facility's capacity to the planned 420 MW. Cinergy is composed of the Swiss-based Asea Brown Boveri (ABB), Industrial Promotion Services (IPS) and EDF.
- Ghana has plans for an additional hydroelectric facility to be located on the Black Volta River at Bui. The facility will have a generating capacity of 400 MW and possibly provide power exports to Burkina Faso, Cote d’Ivoire and Mali.

- A consortium of American and Japanese firms have agreed to build a 220-MW power station in Tema, Ghana. KMR Power (operator), EPDL, and Japan's Marubeni Corporation will build, own and operate the $200-million IPP facility.
- The 75-MW Garafi hydroelectric facility was inaugurated in Guinea in July 1999. It is the country's largest hydroelectric facility and will supply power to Conakny, Guinea's capital. Plans for a larger (900-MW) facility downstream of Garafi on the Konkoure River are being discussed. A feasibility study for the Kaleta project has been completed, and the project, which would be built on a BOT basis, would supply power to the proposed CIFAK Aluminum Smelter.
- Nigeria has signed agreements to develop two IPP projects. Mobil will generate power from a 350-MW, gas-fired facility located at Bonny in south-eastern Rivers State. The state-owned National Electric Power Authority (NEPA) will purchase the electricity generated. Enron has also signed an agreement for the construction of a 540-MW power plant. It was announced in early 1999, that Nigeria will spend an estimated $144 million to rehabilitate six generating facilities.

CAPP (Central Africa Power Pool)

CAPP (or PEAC) was set up on 12th April 2003 and involves: Angola, DR Congo, Congo/Brazzaville, Gabon, Equatorial Guinea, Sao Tome et Principe, Cameroon, Chad, Rwanda and Burundi. Companies interested in the organization are: Ene-ep, Edel, Regideso, Aes Sonel, Enerca, SNE, Snel, Seeg, Segesa, Electrogaz, Emae and Stee.
The main objective is to organize and manage an electric power market to satisfy all power demands in Central Africa through an interconnected electric network.
Nevertheless, the central part of the Africa is the less developed one (perhaps in the world) and the future projects related to the electrification of the region, are very poor, even if there is one of them in particular (the Inga II plant) very big: [A09]

- The Canadian firm, Ocelot Energy, and the Societe Nationale des Hydrocarbures (SNH), Cameroon's state-owned oil firm, have signed a memorandum of understanding for the construction of a 175-megawatts (MW) power facility. The gas-powered facility will be supplied with fuel from the Sanaga Sud field which Ocelot is developing offshore southern Cameroon.

- The Democratic Republic of Congo is planning to develop projects to expand the Inga hydroelectric facility located on the Congo River. The 2,000-MW Inga II plant and the 40,000-MW Grand Inga facility would be utilized primarily for power exports. The combined capacity of these two projects (42,000 MW, which equals 40 big nuke plants, or 100 big coal-fired power plants) is almost as large as Southern Africa's current installed capacity. The Inga Dams on the Congo have the potential to power the entire continent of Africa and its future industrialisation and even sell excess electricity to Europe.
- Three firms, EEF (Switzerland), Infra-Consult (Germany) and Medis (Belgium), have signed an agreement to rehabilitate the Democratic Republic of Congo's Societé Nationale d'Electricité (SNEL) electricity system. The rehabilitation will include work on generation facilities in Kinshasa, as well as production and distribution in North and South Kivu provinces.

EAPP (Eastern Africa Power Pool)

The EAPP was established on 21st February 2003 by the Energy Ministers of Eastern Africa countries who signed the Intergovernmental Memorandum of Understanding (MOU) now in force. Countries involved are: Rwanda, Burundi, DR Congo, Uganda, Kenya, Tanzania, Sudan, Ethiopia, Somalia, Djibouti, Eritrea and Egypt.

This region is very little developed by the infrastructural point of view, also because of the numerous civil wars, that have almost all destroyed and impoverished the economy of many countries. Currently only Djibouti, Ethiopia and Uganda have some valid projects, while Kenya keeps on appraising a lot of possibilities, but in the practice take part almost in any project.

However, the principals projects in this region are: [A09]

- Electricité de Djibouti (EDD) plans to increase generating capacity by 20 MW with the purchase of four, 5-MW, diesel-powered generators. Purchase of the generators is being funded by a loan from the Kuwaiti Fund. EDD also has plans to construct an 18-MW facility in Marabout.

- Studies are being conducted to evaluate the geothermal potential of Eritrea's Alid region. Initial results indicated that temperature and permeability conditions were favourable for an electrical-grade geothermal resource. Djibouti and Uganda are also exploring the possibility of utilizing geothermal resources for power generation.
- The Ethiopian Electric Power Corporation (EEPC) has plans to significantly increase the country's electric generating capacity. A 34-MW hydroelectric plant on the Fincha river in western Ethiopia has been completed, while existing facilities on the Koka and Tis Abay rivers are being upgraded.
- The EEPC is also constructing hydroelectric facilities on Ethiopia's Gilgel-Gibe (184 MW) and Blue Nile (73 MW) rivers. A 150-MW hydroelectric facility on the Gojeb river is expected to become operational by 2003. Additional hydroelectric facilities are planned on the Tekeze, Tana, Beles, and Halele Werabisa rivers.
- Kenya has several independent power projects (IPPs) in various stages of development. The coal-fired Nairobi South plant was completed in 1997, while the 75-MW Kipevu II plant is scheduled for completion by the end of 1999. Kenya plans to generate 25% of its electricity from geothermal energy by 2017.
- Two Chinese firms, the International Water and Electric Company and the Machinery Export and Import Company, have agreed to finance 75% of the Kajbar hydroelectric facility in northern Sudan. The $200 million project will be located on the Nile, and will have a capacity to generate 300 MW.
- The 180-MW Owens Falls hydroelectric facility, located in southern Uganda on the Nile, is being expanded to include an additional 200 MW of generating capacity.

Altogether in Africa there are many projects that foresee the expansion of the electric net, according to the possibilities of every state. The principal obstacles seem to be the dependence from non renewable sources (such as oil, gas, diesel oil, coal) to feed the electric plants. A big problem is also caused by the vandalism (of electric structures) and by the theft (of oil and copper cables), that brings losses for million of dollars, as shown in the chart below, related to the TANESCO, the electric company working in Tanzania.

Year	Number of transformer vandalized	Total cost of the damaged transformers
2000	33	165 million
2001	74	368 million
2002	98	492 million
2003	131	653 million
2004	261	1.304 billion
2005	199	996 million
2006	164	820 million
TOTAL	959	4.798 billion

Table B- 9 Total cost of the damaged transformers (TANESCO)

This whole analysis of the electrical network show how much, before thinking about possible PLC services, is essential a bigger electrification of the African territory. At the moment, apart from the extreme south and the extreme north of the continent, Africa is also in this sense, the black continent (as it can be seen by the image below).

Figure B-7 Taking advantage of the latest techniques for infrastructure investment

B.8 Services offered in Africa

The extension of the telecommunication grid, in Africa, is very limited, nevertheless, where there is it, telecommunication operators offer numerous services, up to the most recent and modern.

The most common services offered by network operators are:

- Dial-Up Connectivity, is the primary connection that allow access speeds up to 56Kbps.
- ISDN (Integrated Services Digital Network), is a technology that allows its users to access data and voice services at the same time, on the same line.

- ADSL (Asymmetric Digital Subscriber Line), the common broadband access technology that utilizes existing telephone lines to provide Internet access.
- VoIP (Voice over IP), is a technology that enables one to make analog calls through the internet.
- IP-TV, is the service that allows to transmit video content on the IP protocol, guaranteeing a suitable quality of the service.
- DVB (Digital Video Broadcast), is a satellite technology that allows to receive high speed Internet access using a satellite connection. DVB is a one-way, downlink-only satellite technology.
- VSAT (Very Small Aperture Terminal), is 2-way satellite service that allows to use a single satellite antenna to send and receive Internet transmissions at the same time.
- VPN's (Virtual Private Networks), is a solution that allow to send and receive sensitive, private and confidential data across the Internet without it being compromised or seen by anyone else along the Internet transmission path.
- MPLS (Multi-Protocol Label Switching), is used for speeding up network traffic flow within the service providers backbone. It can be used to provide clients with QoS (Quality of Service), CoS (Class of Service), TE (Traffic Engineering), and other similar features whose sole purpose is to ensure that clients that require such a service are able to get the access speed they or their businesses require, regardless of the whether the backbone network is congested or not.
- Broadband Wireless, both mobile and fixed. It is capable of providing dedicated and shared access speeds from 32Kbps up to 1Mbps, and more.
- AMR (Automatic Meter Reading), is a service that allows to known some information from remote, using the electric network. Currently, it is used above all by telephonic and electrical operators to deliver the invoice of the bill to the consumers.
- PLC (PowerLine Communications), is the technology that allows to receive data from the power line.

B.8.1 Internet service providers and Media broadcasters operators

At the beginning of the Appendix B they are listed, for every African country, the principal suppliers of the internet connection and the broadcast operators (RD for Radio, TV for Television). All those that intend to offer a new internet access service or some new multimedial content, have to hold in consideration these actual operators.

B.8.2 VoIP service providers

Almost all ISPs offer also a VoIP offer and some operators are exclusively specialized in the Voice over IP service.

One of these, is Connection Telecom (a Digium Distribution's partner), that using software open source and Linux base, it is able to offer a VoIP service at lower price: R45.00 (€ 4.6) for a SIP/IAX2 personal account, R95.00 (€ 9.8) for a IAX2 Trunk account, R195.00 (€ 20) for an ADSL VoIP & Internet account (price are intended per month).

Another operator specialized in VoIP is Miro Distribution, that also uses Asterisk and Digium technologies and open source programs.

The two greatest telephone operators are however MTN an Vodacom, in the last times in struggle for the primacy in the VoIP market.

In particular, MTN doesn't offer the possibility to transmit data, to use Skype and MXit, or to use P2P services on the VoIP line, but it foresees the possibility of it payment solo. Instead Vodacom is not interested in the type of data transmitted in the VoIP traffic and it doesn't stop any type of data. Telkom do the same, also if effects politics to give the priority to some types of data, web content (http protocol), email (smtp), FTP traffic, to damage of others, as VoIP and P2P.

B.8.3 e-Services

<u>e-Learning</u>

[A20] University students will make up Africa’s next generation of leadership. For those unable to get scholarships to study internationally, it is extremely important that they have access to the ideas and knowledge available in other countries. Few African universities have internet access for all students, and where some provision is available, cost remains a key issue for the institutions. Many research institutions are not linked to their counterparts in other African countries or to others elsewhere in the world.

To compensate this lack, numerous initiatives have risen, with the purpose to offer to the African students, more possibilities of knowledge and growth. Some of these are: [A21]

- Acacia Initiative (www.idrc.ca/acacia): The Acacia initiative is an international program to empower Sub-Saharan communities with the ability to apply information and communication technologies (ICTs) to their own social and economic development.
- African Information Society Initiative (AISI) (www.uneca.org/aisi): The African Information Society Initiative (AISI) is a mission statement for Africa's quest to bridge the digital divide between Africa and the rest of the world, and to speed the continent's entry into the information age.
- SchoolNet Africa (www.schoolnetafrica.com): is an independent non-government organization which promotes education through the use for Information and Communication Technologies (ICTs) in African schools. It is the first African-based, African-led, Pan-African school networking institution. It works in partnership with national school-net organizations in up to 28 African countries. It stands for the right of every African child to have access to Information & Knowledge and to be a global citizen.
- African Virtual University (www.avu.org): The African Virtual University (AVU) is a "university without walls" that uses modern information and communication technologies to give the countries of sub-Saharan Africa direct access to some of the highest quality learning resources throughout the world. AVU is bridging the digital divide by training world-class business managers, engineers, technicians, scientists and other professionals who will promote economic and social development and help propel Africa into the knowledge age.
- The Information for Development Program (infoDev) (www.infodev.org): The infoDev began in September 1995 with the objective of addressing the obstacles facing

developing countries in an increasingly information-driven world economy. It is a global grant program managed by the World Bank to promote innovative projects on the use of information and communication technologies (ICTs) for economic and social development, with a special emphasis on the needs of the poor in developing countries.

- The Partnership for Information and Communication Technologies in Africa (PICTA) (www.uneca.org/aisi/pictal): PICTA is an informal group of donors and executing agencies committed to improving information exchange and collaboration around ICT activities in Africa. It builds on the work of the African Networking Initiative (ANI) and the African Internet Forum (AIF).

Another good initiative is SchoolWAN (www.schoolwan.org.za), a new project, mainly driven by volunteers and sponsor companies, to inter-connect schools in South Africa, provideing e-mail access and local content services. It has a strong open source strategy and makes use of cost effective wireless technologies.
SchoolWAN currently have more than 80 schools connected to the Wide Area Network.
At the moment most schools connect using outdoor fixed wireless (Wi-Fi) connections, but there are a number of schools that connect with dial-up modems.

<u>e-Banking</u>
An interesting initiative has been launched from Simba Telecoms, an East African cell phone company that introduced an innovative local money transfer service in Uganda.
[A22] The system was built using a variety of open source tools. The new service, Simba cash, aims to overcome the challenge facing much of the population in Uganda that banks are often inaccessible to rural communities, both through geography and cost.
To use the money transfer service, customers can visit any of the Simba Telecoms branches across Uganda to deposit money. The customer is then given a password which is forwarded to the recipient of the money. The recipient can then take their identification and the password to any other Simba branch to collect the money.

The application was developed with an open source Integrated Development Environment from SUN called NetBeans. The language used to develop the application (Java) is provided by SUN and has been open sourced. Finally the application server is also open source.

Some banks offering some service online, are instead:

- ABSA Internet Banking (www.absadirect.co.za)
- Nedbank (netbank.nedsecure.co.za)
- First National Bank (www.fnb.co.za)
- Standard Bank (www.standardbank.co.za)

all situated in South Africa.

e-Commerce

[A23] Online retail in South Africa grew by 20% in 2005, down from the 25% growth rate of 2004, as the industry finds itself lagging due to the high cost of broadband Internet access in South Africa. The total spent on online retail goods in South Africa in 2005 was R514-million, up from R428-million in 2004, according to a new report from World Wide Worx.

These figures exclude the sale of air tickets online, which dwarf the numbers for online retail. The four South African airlines selling tickets online, namely kulula.com, FlySAA.com, 1Time and Nationwide between them account for R1.8-billion in e-commerce in 2005, more than doubling the 2004 figure of R850-million, and more than three times the size of conventional online retail.

Kulula.com has in fact been the single biggest success story of e-commerce in South Africa, and is the first South African consumer web site to reach R1-billion in online sales in a single year. It is abundantly clear that online ticketing of air travel will continue to dominate consumer e-commerce in South Africa for at least the next five to ten years, given present growth trends in conventional online retail.

The total spent online on retail goods during the November-December 2005 holiday season fell to 16% of annual sales from the 20% average across all online retailers that was reported in 2002 and 2003 and the 18% in 2004.

The number of online retail sites has grown substantially, from 719 at the end of 2003 to 826 at the end of 2005. The fastest growing major categories in terms of number of sites were auctions (230% increase in sites), gifts (50%) and apparel (32%). Gifts have been identified as representing significant opportunity, but by the same token has become one of the areas of greatest competition in online retail.

The market is dominated by ten online retail sites, which between them account for most online retail sales in South Africa. They are the two major malls, M-Web ShopZone and Digital Mall, the two largest online grocers, Pick 'n' Pay Home Shopping and Woolworths, the two largest online book retailers, Kalahari.net and Exclusive Books, the largest online florist NetFlorist, the largest online wine retailer Cybercellar, the largest online electronics store Digital Planet, and the largest online health and beauty store, Ascot Direct. Kalahari.net also dominated several other categories, including Music, where Look 'n Listen and Musica are expected to offer serious competition, and movies, where it has almost no competition.

The biggest obstacle to growth identified by all the executives we interviewed continued to be speed of Internet access, and more specifically lack of affordable access to broadband. But there is a growing realisation that the growing experience levels of users will also make a significant impact.

Other companies offering online products, operating out of South Africa, are:

- in Algeria: a list is available at the address www.djazaironline.net/business_economy/companies.htm
- in Burkina Faso: Hôtel Indépendence (www.hotelinde.com), Cofama Burkina Faso (www.cenatrin.bf/cofama), CENATRIN (www.cenatrin.bf), Festival Panafrican du cinéma de Ouagadougou (www.fespaco.bf)
- in Gabon: GETMA Gabon (www.utrac.com/contacts/gabon.htm), ESTTM - Health and Security (www.utrac.com/contacts/gabon.htm), SAFT Telecom (www.utrac.com/contacts/gabon.htm), SACOA (r-plus.com/sacoa), ENERDAS - Solar Energy Provider (www.enerdas.com)
- in Tunisia: a list of commercial websites is available at the address www.tunisinfo.com/enterprise.htm

B.8.4 IP-TV service providers

The IP-TV service is not very diffused in Africa, but many companies intend to enter on this market.

[A24] Currently, Telkom South Africa has been awarded a pay-TV licence by the country's communications regulator ICASA. Three other firms - Hosken Consolidated Investments, Walking On Water and OnDigital - were also granted concessions; 18 companies had originally applied for licences. Telkom says its media division expects to launch commercial pay-TV services within 12-18 months.

B.8.5 The market of the AMR

An actual trend, sees the widespread introduction of Automated Meter Reading (AMR) technology, which is based on one-way or two-way communication and allows utility companies to take remote wireless meter readings from either a handheld device or a static base station. One of the principal firms dealing with this sector is Elster.

[A25] Elster Group is the world's leading manufacturer and supplier of highly accurate, high quality, integrated metering and utilization solutions to the gas, electricity and water industries. Elster is at the forefront of developing the next generation of data intelligence technology for metering. Known as Advanced Metering Infrastructure (AMI), it provides utilities with a host of invaluable functionality, from leakage detection for water meters to outage management via electricity meters.

Elster is also present in South Africa, in Johannesburg.

B.8.6 Internet service providers

Telkom is Africa's largest integrated communications company. It operates in South Africa, where up to a year ago, it had a position of uncontested monopoly. Telkom offers many services, among which: internet services (DSL, ISDN, Satellite, Domain Name Services, Hosting, VoIP), line services (Telephone lines, ISDN lines, Prepaid fone), call services (BlockCallPlus, Call Answer, WorldCall), phones equipment (PC and modems, phone instruments), online services (Your Bill Online, SmartMoves, Telkom PDC) and invoice services (Understand Your Invoice).

Another big firm, operating in South Africa, is Telesciences, which provide access solutions based on fibre optic equipment, VoIP and VoD (Video on Demand) services, WLAN solutions (using Aruba's tecnology), Integrated Access Devices (IAD), Customer Premise Gateways (CPG) and the very publicized “Triple Play” solution: this platforms allow for services delivery of voice, data and video services.

A firm specialized in wireless communications is instead Wireless Online, located in Cape Town, South Africa. Wireless Online provides broadband internet without the need of a phone line. The starting packet foresees a bandwidth of 512 Kb and it is sold at the price of 169 Rand. The most expensive solution is sold at 999 Rand and it foresees 1 M of bandwidth.

A complete and diffused, at least in South Africa, Internet Service Provider, is Snowball (www.snowball.co.za). It offers wireless connections beginning from 200 Rand (512 Kb of bandwidth), up to 650 Rand (2048 Kb of bandwidth). ADSL is offred at R 152 (384/128 Kbit/s), up to R 413 (4096/384 Kbit/s), on Telkom's lines. They are available also ADSL to consumption (1GB of data at R 70 and 10GB at R 490). The ADSL can also be furnished via satellite or via fiber optics, at the price of R 1539 p/m for 512 Kbit (R 3078 for 1024 Kbit) and R 2850 p/m for 512 Kbit (R 5700 for 1024 Kbit) respectively. Snowball offers also the traditional analog dial-up and the ISDN dial-up (64 Kbps) access at R 70 per month, while the ISDN dial-up at 128 Kbps is sold at R 140.

A complementary to Telkom provider is instead Breedenet (www.breede.co.za). Breedenet Internet is the largest wireless internet service provider in the greater Breede River Valley. Breedenet has many clients situated outside of Telkom's service areas for ISDN and ADSL. The South African ISP offers a 1GB wireless connection at R295 per month and a 5GB wireless connection at R795 per month.

Another important provider is Amobia (www.amobia.com). Amobia is a 100% South African owned company offering fast, cost effective access to a range of wireless services. Amobia offers, among he various alternatives, a 128 Kbps always-on wireless solution at R398 per month (R2499 for the installation) and a 1024 broadband internet access at R299 (2000 MB capped).

Another South African ISP is Aerosat (www.aerosat.co.za), located in Port Elizabeth. It offers ADSL internet packages, dial-up traditional solution and SatDSL (always-on wireless broadband solution). The ADSL solution is sold at R275 for the 512 Kbit/s with 3 GB of data cap (R1699 for the uncapped one). Dial-up solution is offered at R50 per month (R180 for the 128 Kbit/s ISDN dial-up). The SatDSL solution is sold instead, at R295 for the 64 Kbit/s access and at R950 for the 512 Kbit/s access (both always-on). Also Aerosat, as the most greater part of the South Africans ISPs, furnish its services above the Telkom's network.

At the moment, cheapest broadband is offered, in South Africa, by Sentech.
[A27] Their MyWireless broadband products, make them the most affordable broadband provider in South Africa. On the low usage side, Sentech has cracked the R 100 barrier with its 150 MB offering for R 99 per month. Its 500 MB offering comes in at R 199, cheaper than similar services in the market while its 1 GB package is priced at R 299. There is also a 2 GB package available to consumers at R 449, a little more expensive than MTN's R 399, but still competitively priced when compared with iBurst, Vodacom and CellC. One of the major barriers of entry to the wireless broadband market is the relatively high cost of the modems required to access the service. New modem prices will also be reduced from R 2600 to R 1500.

As it regards the mobile telephony operators, the undisputed leaders are Vodacom (www.vodacom.co.za) and MTN (www.mtnsms.com). Vodacom, in particular, partly owned by the colossus Vodafone, operate in five countries on the continent. In all, it has to 10.32

million people talking on its network in South Africa, DR Congo, Lesotho, Mozambique and Tanzania (and soon in Nigeria too).

Orange instead, owned by France Telecom, is present in West Africa, as Orange Bissau, a newly formed Sonatel subsidiary. It operates in Guinea Bissau and Guinea from the first half of 2007.

[A26] In Guinea, Sonatel has purchased the mobile license formerly held by the operator Spacetel, for a renewable term of 15 years. In Africa, Orange is already present in Botswana, Cameroon, Ivory Coast, Equatorial Guinea, Madagascar, Mali, and Senegal, and serves nearly 10 million customers in this region of the world.

The principal supplier of technology for mobile services in Africa is Huawei (www.huawei.com). In Sub-Sahara Africa region, Huawei service has set foot on over 30 countries for about 60 telecom operators, such as MTN, Millicom, Orange, Celtel, TelKom, TKL, ETC, Safaricom, Cell C, Vodacom, Telcel, Globacom, etc.

Huawei provides CDMA products and multi-frequency solutions for Starcomms in Nigeria and TKL in Kenya; in Mauritius, Huawei offers the first 3G network solutions in Africa market for Emtel, and triple-play core network solutions for Telecom. Huawei is regarded as a vanguard vendor who has introduced CDMA technology to more than 30 countries in Africa market. Customized wireless network solutions, like low-cost GSM deployed in Madagascar, Mali and Senegal, are other significant services Huawei tapped for Africa.

In Africa, Huawei is present in Algeria, Angola, Botswana, Egypt, Kenya, Madagascar, Mauritana, Mauritius, Mozambique, Namibia, Nigeria, South Africa, Tunisia, Uganda, Zambia and Zimbabwe. Huawei also has announced the launch of high bandwidth services such as Video on Demand, Internet games and IP-TV, optical fiber access (FTTx) in Morocco.

APPENDIX C (ASIA)

C.1 Electricity production of the Asian countries.

The following data are updated on November 2007 and taken from “CIA World FactBook”.

Country	Area (km^2)	Population	Electricity (kWh)			
			Production	Consumption	Imports	Exports
Afghanistan	647,500	31,889,923	754.2 million	801.4 million	100 million	0
Armenia	29,800	2,971,650	5.975 billion	4.194 billion	231 million	1.011 billion
Azerbaijan	86,600	8,120,247	20.1 billion	19.08 billion	2.082 billion	880 million
Bahrain	665	708,573	8.187 billion	7.614 billion	0	0
Bangladesh	144,000	150,448,339	21.35 billion	19.49 billion	0	0
Bhutan	47,000	2,327,849	2 billion	380 million	20 million	1.5 billion
Brunei	5,770	374,577	2.735 billion	2.625 billion	0	0
Burma (Myanmar)	678,500	47,373,958	5.806 billion	3.707 billion	0	0
Cambodia	181,040	13,995,904	134 million	206.9 million	82 million	0
China	9,596,960	1,321,851,888	2.372 trillion	2.197 trillion	5.011 billion	11.19 billion
Georgia	69,700	4,646,003	7.142 billion	7.354 billion	1.468 billion	122 million
Hong Kong	1,092	6,980,412	36.14 billion	37.74 billion	11 billion	4.498 billion
India	3,287,590	1,129,866,154	661.6 billion	488.5 billion	1.764 billion	67 million
Indonesia	1,919,440	234,693,997	120.3 billion	105.3 billion	0	0
Iran	1,648,000	65,397,521	170.4 billion	136.2 billion	2.074 billion	2.761 billion

Iraq	437,072	27,499,638	34.6 billion	31.25 billion	1.388 billion	0
Israel	20,770	6,426,679	46.85 billion	43.28 billion	0	1.663 billion
Japan	377,835	127,433,494	1.025 trillion	974.2 billion	0	0
Jordan	92,300	6,053,193	9.074 billion	8.49 billion	741 million	4 million
Kazakhstan	2,717,300	15,284,929	64.23 billion	57.99 billion	4.552 billion	3.978 billion
Korea, North	120,540	23,301,725	22.19 billion	18.57 billion	0	0
Korea, South	98,480	49,044,790	366.2 billion	325.5 billion	0	0
Kuwait	17,820	2,505,559	41.11 billion	36.28 billion	0	0
Kyrgyzstan	198,500	5,284,149	15.15 billion	8.206 billion	0	2.684 billion
Laos	236,800	6,521,998	1.715 billion	1.193 billion	326 million	728 million
Lebanon	10,400	3,925,502	9.571 billion	8.439 billion	455 million	0
Malaysia	329,750	24,821,286	82.36 billion	78.72 billion	0	0
Maldives	300	369,031	169 million	157.1 million	0	0
Mongolia	1,564,116	2,951,786	3.43 billion	2.94 billion	125 million	15.95 million
Nepal	147,181	28,901,790	2.511 billion	1.96 billion	266 million	101 million
Oman	212,460	3,204,897	11.89 billion	8.661 billion	0	0
Pakistan	803,940	164,741,924	89.82 billion	67.06 billion	0	0

Philippines	300,000	91,077,287	53.67 billion	46.86 billion	0	0
Qatar	11,437	907,229	13.54 billion	12.52 billion	0	0
Russia	17,075,200	141,377,752	904.4 billion	779.4 billion	10.14 billion	22.52 billion
Saudi Arabia	2,149,690	27,601,038	165.6 billion	146.9 billion	0	0
Singapore	693	4,553,009	35.92 billion	33.99 billion	0	0
Sri Lanka	65,610	20,926,315	8.411 billion	7.072 billion	0	0
Syria	185,180	19,314,747	33.01 billion	24.74 billion	0	0
Taiwan	35,980	22,858,872	210.3 billion	201.6 billion	0	0
Tajikistan	143,100	7,076,598	16.89 billion	14.66 billion	4.508 billion	4.257 billion
Thailand	514,000	65,068,149	124.6 billion	117.7 billion	4.419 billion	642 million
Turkey	780,580	71,158,647	154.2 billion	129 billion	636 million	1.798 billion
Turkmenistan	488,100	5,097,028	12.05 billion	7.602 billion	0	2.918 billion
United Arab Emirates	83,600	4,444,011	57.06 billion	52.62 billion	0	0
Uzbekistan	447,400	27,780,059	49 billion	47 billion	10.5 billion	6.8 billion
Vietnam	329,560	85,262,356	51.33 billion	45.46 billion	0	0
Yemen	527,970	22,230,531	4.456 billion	3.381 billion	0	0

Table C- 1 Electricity production of the Asian countries

C.2 Telephone lines and internet users in Asia

The following table shows the number of telephone main lines, mobile cellular and internet users for every Asian country.

The data are updated on November 2007 and taken from the "CIA World FactBook".

Country	Population	Telephones		Internet users
		Main lines use	Mobile cellular	
Afghanistan	31,889,923	280,000	2.52 million	535,000
Armenia	2,971,650	594,400	318,000	172,800
Azerbaijan	8,120,247	1.189 million	3.324 million	829,100
Bahrain	708,573	193,300	898,900	157,300
Bangladesh	150,448,339	1.134 million	19.131 million	450,000
Bhutan	2,327,849	31,500	82,100	30,000
Brunei	374,577	80,200	254,000	165,600
Burma (Myanmar)	47,373,958	503,900	183,400	31,500
Cambodia	13,995,904	32,800	1.14 million	44,000
China	1,321,851,888	368 million	461.1 million	137 million
Georgia	4,646,003	553,100	1.704 million	332,000
Hong Kong	6,980,412	3.85 million	9.356 million	3.77 million
India	1,129,866,154	49.75 million	166.1 million	60 million
Indonesia	234,693,997	14.821 million	63.803 million	16 million

Iran	65,397,521	21.981 million	13.659 million	18 million
Iraq	27,499,638	1.547 million	8.7 million	36,000
Israel	6,426,679	3.005 million	8.404 million	1.899 million
Japan	127,433,494	55.155 million	101.7 million	87.54 million
Jordan	6,053,193	614,000	4.343 million	796,900
Kazakhstan	15,284,929	2.928 million	7.83 million	1.247 million
Korea, North	23,301,725	980,000	NA	NA
Korea, South	49,044,790	26.866 million	40.197 million	34.12 million
Kuwait	2,505,559	510,300	2.536 million	816,700
Kyrgyzstan	5,284,149	440,400	541,700	298,100
Laos	6,521,998	90,067	638,200	25,000
Lebanon	3,925,502	681,400	1.103 million	950,000
Malaysia	24,821,286	4.342 million	19,464	11.292 million
Maldives	369,031	32,500	262,600	20,100
Mongolia	2,951,786	156,000	557,200	268,300
Nepal	28,901,790	595,800	1.042 million	249,400
Oman	3,204,897	278,300	1.818 million	319,200
Pakistan	164,741,924	5.24 million	63.16 million	12 million
Philippines	91,077,287	3.367 million	41.6 million	4.615 million
Qatar	907,229	228,300	919,800	289.900

Russia	141,377,752	40.1 million	120 million	25.689 million
Saudi Arabia	27,601,038	4.5 million	19.663 million	4.7 million
Singapore	4,553,009	1.854 million	4.789 million	1.717 million
Sri Lanka	20,926,315	2.087 million	5.959 million	428,000
Syria	19,314,747	2.903 million	4.675 million	1.5 million
Taiwan	22,858,872	14.497 million	23.249 million	13.21 million
Tajikistan	7,076,598	280,200	265,000	19,500
Thailand	65,068,149	7.073 million	40.816 million	8.466 million
Turkey	71,158,647	18.978 million	43.609 million	12.284 million
Turkmenistan	5,097,028	495,200	105,000	64,800
United Arab Emirates	4,444,011	1.31 million	5.519 million	1.709 million
Uzbekistan	27,780,059	1.793 million	1.1 million	1.7 million
Vietnam	85,262,356	15.845 million	15.505 million	14.684 million
Yemen	22,230,531	968,400	2 million	270,000

Table C- 2 Telephone lines and internet users in Asia

C.3 Telephone system in Asia

The following table shows the general situation of the access to the information in the various Asian countries.

Data updated on 2007 and taken from the “CIA World FactBook”.

Country	Telephone system

Afghanistan	*general assessment:* very limited telephone and telegraph service; many Afghans utilize growing cellular phone coverage in major cities. *domestic:* telephone service is improving with the licensing of several wireless telephone service providers in 2005 and 2006; approximately 8 in 100 Afghans own a wireless telephone; telephone main lines remain limited. *international:* country code - 93; five VSAT's installed in Kabul, Herat, Mazar-e-Sharif, Kandahar, and Jalalabad provide international and domestic voice and data connectivity.
Armenia	*general assessment:* system inadequate; an outdated telecommunications network inherited from the Soviet era; now 90% privately owned and undergoing modernization and expansion; mobile-cellular services monopoly terminated in late 2004 and a second provider began operations in mid-2005. *domestic:* the majority of subscribers and the most modern equipment, including paging and mobile-cellular services, are in Yerevan. *international:* country code - 374; Yerevan is connected to the Trans-Asia-Europe fiber-optic cable through Iran; additional international service is available by microwave radio relay and landline connections to the other countries of the Commonwealth of Independent States and through the Moscow international switch and by satellite to the rest of the world; satellite earth stations - 3.
Azerbaijan	*general assessment:* inadequate; requires considerable expansion and modernization; teledensity of 15 main lines per 100 persons is low; mobile cellular penetration is increasing and is currently about 40 telephones per 100 persons. *domestic:* fixed-line telephony and a broad range of other telecom services are controlled by a state-owned telecoms monopoly and growth has been stagnant; more competition exists in the mobile-cellular market with three providers in 2006; satellite service connects Baku to a modern switch in its exclave of Naxcivan. *international:* country code - 994; the old Soviet system of cable and microwave is still serviceable; satellite earth stations - 2.
Bahrain	*general assessment:* modern system. *domestic:* modern fiber-optic integrated services; digital network with rapidly growing use of mobile-cellular telephones. *international:* country code - 973; landing point for the Fiber-Optic Link Around the Globe (FLAG) submarine cable network that provides links to Asia, Middle East, Europe, and US; tropospheric scatter to Qatar and UAE; microwave radio relay to Saudi Arabia; satellite earth stations - 1.
Bangladesh	*general assessment:* totally inadequate for a modern country; fixed-line telephone density of less than 1 per 100 persons; mobile-cellular telephone density of 13 per 100 persons. *domestic:* modernizing; introducing digital systems; trunk systems include VHF and UHF microwave radio relay links, and some fiber-optic cable in cities. *international:* country code - 880; landing point for the SEA-ME-WE-4 fiber-optic submarine cable system that provides links to Europe, the Middle East and Asia; satellite earth stations - 6; international radiotelephone communications and landline

	service to neighboring countries.
Bhutan	*general assessment:* telecommunications facilities are poor. *domestic:* very low teledensity; domestic service is very poor especially in rural areas; wireless service available since 2003. *international:* country code - 975; international telephone and telegraph service via landline and microwave relay through India; satellite earth station - 1.
Brunei	*general assessment:* service throughout the country is excellent; international service is good to Southeast Asia, Middle East, Western Europe, and the US. *domestic:* every service available. *international:* country code - 673; landing point for the SEA-ME-WE-3 optical telecommunications submarine cable that provides links to Asia, the Middle East, and Europe; the Asia-America Gateway submarine cable network, scheduled for completion by late 2008, will provide new links to Asia and the US; satellite earth stations - 2 Intelsat (1 Indian Ocean and 1 Pacific Ocean).
Burma (Myanmar)	*general assessment:* barely meets minimum requirements for local and intercity service for business and government; international service is fair. *domestic:* NA *international:* country code - 95; landing point for the SEA-ME-WE-3 optical telecommunications submarine cable that provides links to Asia, the Middle East, and Europe; satellite earth stations - 2, Intelsat (Indian Ocean), and ShinSat.
Cambodia	*general assessment:* mobile-phone systems are widely used in urban areas to bypass deficiencies in the fixed-line network; fixed-line connections stand at well less than 1 per 100 persons; mobile-cellular usage, aided by increasing competition among service providers, is increasing and stands at about 8 per 100 persons. *domestic:* adequate landline and/or cellular service in Phnom Penh and other provincial cities; mobile-phone coverage is rapidly expanding in rural areas. *international:* country code - 855; adequate but expensive landline and cellular service available to all countries from Phnom Penh and major provincial cities; satellite earth station - 1 Intersputnik (Indian Ocean region).
China	*general assessment:* domestic and international services are increasingly available for private use; unevenly distributed domestic system serves principal cities, industrial centers, and many towns; China continues to develop its telecommunications infrastructure, and is partnering with foreign providers to expand its global reach; 3 of China's 6 major telecommunications operators are part of an international consortium which, in December 2006, signed an agreement with Verizon Business to build the first next-generation optical cable system directly linking the US mainland and China. *domestic:* interprovincial fiber-optic trunk lines and cellular telephone systems have been installed; mobile-cellular subscribership is increasing rapidly; broadband Internet subscribership reached 50 million in 2006; a domestic satellite system with 55 earth stations is in place. *international:* country code - 86; a number of submarine cables provide connectivity to Asia, the Middle East, Europe, and the US; satellite earth stations - 5 Intelsat (4 Pacific

	Ocean and 1 Indian Ocean), 1 Intersputnik (Indian Ocean region) and 1 Inmarsat (Pacific and Indian Ocean regions).
Georgia	*general assessment:* NA *domestic:* local - T'bilisi, K'ut'aisi, and Batumi have cellular telephone networks; urban telephone density is about 20 per 100 people; rural telephone density is about 4 per 100 people; intercity facilities include a fiber-optic line between T'bilisi and K'ut'aisi; nationwide pager service is available. *international:* country code - 995; Georgia and Russia are working on a fiber-optic line between P'ot'i and Sochi (Russia); present international service is available by microwave, landline, and satellite through the Moscow switch; international electronic mail and telex service are available.
Hong Kong	*general assessment:* modern facilities provide excellent domestic and international services. *domestic:* microwave radio relay links and extensive fiber-optic network. *international:* country code - 852; satellite earth stations - 3 Intelsat (1 Pacific Ocean and 2 Indian Ocean); coaxial cable to Guangzhou, China; access to 5 international submarine cables providing connections to ASEAN member nations, Japan, Taiwan, Australia, Middle East, and Western Europe.
India	*general assessment:* recent deregulation and liberalization of telecommunications laws and policies have prompted rapid growth; local and long distance service provided throughout all regions of the country, with services primarily concentrated in the urban areas; steady improvement is taking place with the recent admission of private and private-public investors, but telephone density remains low at about 10 for each 100 persons nationwide and only 1 per 100 persons in rural areas; there remains a national waiting list of over 1.7 million; fastest growth is in cellular service with modest growth in fixed lines. *domestic:* expansion of domestic service, although still weak in rural areas, resulted from increased competition and dramatic reductions in price led in large part by wireless service; mobile cellular service (both CDMA and GSM) introduced in 1994 and organized nationwide into four metropolitan cities and 19 telecom circles each with about three private service providers and one state-owned service provider; in recent years significant trunk capacity added in the form of fiber-optic cable and one of the world's largest domestic satellite systems, the Indian National Satellite system (INSAT), with 6 satellites supporting 33,000 very small aperture terminals (VSAT). *international:* country code - 91; satellite earth stations - 8 Intelsat (Indian Ocean) and 1 Inmarsat (Indian Ocean region); 9 gateway exchanges operating from Mumbai (Bombay), New Delhi, Kolkata (Calcutta), Chennai (Madras), Jalandhar, Kanpur, Gandhinagar, Hyderabad, and Ernakulam; 6 submarine cables, including Sea-Me-We-3 with landing sites at Cochin and Mumbai (Bombay), Sea-Me-We-4 with landing site at Chennai, Fiber-Optic Link Around the Globe (FLAG) with landing site at Mumbai (Bombay), South Africa - Far East (SAFE) with landing site at Cochin, i2icn linking to Singapore with landing sites at Mumbai (Bombay) and Chennai (Madras), and Tata Indicom linking Singapore and Chennai (Madras), provide a significant increase in the bandwidth available for both voice and data traffic.

Indonesia	*general assessment:* domestic service fair, international service good. *domestic:* interisland microwave system and HF radio police net; domestic satellite communications system. *international:* country code - 62; satellite earth stations - 2 Intelsat (1 Indian Ocean and 1 Pacific Ocean).
Iran	*general assessment:* inadequate, but currently being modernized and expanded with the goal of not only improving the efficiency and increasing the volume of the urban service but also bringing telephone service to several thousand villages, not presently connected. *domestic:* the addition of new fiber cables and modern switching and exchange systems installed by Iran's state-owned telecom company have improved and expanded the main line network greatly; main line availability has more than doubled to 19 million lines since 1995; additionally, mobile service has increased dramatically serving some 8.5 million subscribers in 2005. *international:* country code - 98; HF radio and microwave radio relay to Turkey, Azerbaijan, Pakistan, Afghanistan, Turkmenistan, Syria, Kuwait, Tajikistan, and Uzbekistan; submarine fiber-optic cable to UAE with access to Fiber-Optic Link Around the Globe (FLAG); Trans-Asia-Europe (TAE) fiber-optic line runs from Azerbaijan through the northern portion of Iran to Turkmenistan with expansion to Georgia and Azerbaijan; satellite earth stations - 9 Intelsat and 4 Inmarsat.
Iraq	*general assessment:* the aftermath of the liberation of Iraq in 2003 severely disrupted telecommunications throughout Iraq including international connections; USAID repaired switching capabilities and constructed a mobile and satellite communication facility; landlines now exceed pre-war levels. *domestic:* repairs to switches and lines destroyed during 2003 have been completed, but sabotage remains a problem; additional switching capacity is improving access; cellular service is widely available in major cities and centered on 3 regional GSM networks, improving country-wide connectivity; there are currently 8.7 million users of cellular services. *international:* country code - 964; satellite earth stations - 2 Intelsat (1 Atlantic Ocean and 1 Indian Ocean), 1 Intersputnik (Atlantic Ocean region), and 1 Arabsat (inoperative); coaxial cable and microwave radio relay to Jordan, Kuwait, Syria, and Turkey; despite a new satellite gateway, international calls outside of Baghdad are sometimes problematic.
Israel	*general assessment:* most highly developed system in the Middle East although not the largest. *domestic:* good system of coaxial cable and microwave radio relay; all systems are digital. *international:* country code - 972; 3 submarine cables; satellite earth stations - 3 Intelsat (2 Atlantic Ocean and 1 Indian Ocean).
Japan	*general assessment:* excellent domestic and international service. *domestic:* high level of modern technology and excellent service of every kind. *international:* country code - 81; satellite earth stations - 5 Intelsat (4 Pacific Ocean

	and 1 Indian Ocean), 1 Intersputnik (Indian Ocean region), and 1 Inmarsat (Pacific and Indian Ocean regions); submarine cables to China, Philippines, Russia, and US (via Guam).
Jordan	*general assessment:* service has improved recently with increased use of digital switching equipment, but better access to the telephone system is needed in the rural areas and easier access to pay telephones is needed by the urban public. *domestic:* microwave radio relay transmission and coaxial and fiber-optic cable are employed on trunk lines; considerable use of mobile cellular systems; Internet service is available. *international:* country code - 962; satellite earth stations - 3 Intelsat, 1 Arabsat, and 29 land and maritime Inmarsat terminals; fiber-optic cable to Saudi Arabia and microwave radio relay link with Egypt and Syria; connection to international submarine cable FLAG (Fiber-Optic Link Around the Globe); participant in MEDARABTEL; international links total about 4,000.
Kazakhstan	*general assessment:* service is poor; equipment antiquated. *domestic:* intercity by landline and microwave radio relay; mobile cellular systems are available in most of Kazakhstan. *international:* country code - 7; international traffic with other former Soviet republics and China carried by landline and microwave radio relay and with other countries by satellite and by the Trans-Asia-Europe (TAE) fiber-optic cable; satellite earth stations - 2 Intelsat.
Korea, North	*general assessment:* NA *domestic:* NA *international:* country code - 850; satellite earth stations - 1 Intelsat (Indian Ocean) and 1 Russian (Indian Ocean region); other international connections through Moscow and Beijing.
Korea, South	*general assessment:* excellent domestic and international services. *domestic:* NA *international:* country code - 82; fiber-optic submarine cables - 1 Korea-Russia-Japan, 1 Korea-Japan-Hong Kong, 3 Korea-Japan-China, 1 Korea-Japan-China-Europe, 1 Korea-Japan-China-US-Taiwan, 1 Korea-Japan-China, 1 Korea-Japan-Hong Kong-Taiwan, 1 Korea-Japan; satellite earth stations - 3 Intelsat (1 Pacific Ocean and 2 Indian Ocean) and 3 Inmarsat (1 Pacific Ocean and 2 Indian Ocean).
Kuwait	*general assessment:* the quality of service is excellent. *domestic:* new telephone exchanges provide a large capacity for new subscribers; trunk traffic is carried by microwave radio relay, coaxial cable, and open-wire and fiber-optic cable; a cellular telephone system operates throughout Kuwait, and the country is well supplied with pay telephones. *international:* country code - 965; coaxial cable and microwave radio relay to Saudi Arabia; linked to Bahrain, Qatar, UAE via the Fiber-Optic Gulf (FOG) cable; satellite earth stations - 3 Intelsat (1 Atlantic Ocean, 2 Indian Ocean), 1 Inmarsat (Atlantic

	Ocean), and 2 Arabsat.
Kyrgyzstan	*general assessment:* telecommunications infrastructure is growing; fixed line penetration remains low and concentrated in urban areas. *domestic:* 4 mobile cellular service providers with growing coverage. *international:* country code - 996; connections with other CIS countries by landline or microwave radio relay and with other countries by leased connections with Moscow international gateway switch and by satellite; satellite earth stations - 1 Intersputnik, 1 Intelsat; connected internationally by the Trans-Asia-Europe (TAE) fiber-optic line.
Laos	*general assessment:* service to general public is poor but improving; the government relies on a radiotelephone network to communicate with remote areas. *domestic:* radiotelephone communications. *international:* country code - 856; satellite earth station - 1 Intersputnik (Indian Ocean region).
Lebanon	*general assessment:* repair of the telecommunications system, severely damaged during the civil war, now complete. *domestic:* 2 commercial wireless networks provide good service; political instability hampers privatization and deployment of new technologies. *international:* country code - 961; satellite earth stations - 2 Intelsat (1 Indian Ocean and 1 Atlantic Ocean) (erratic operations); coaxial cable to Syria; 3 submarine coaxial cables.
Malaysia	*general assessment:* modern system; international service excellent. *domestic:* good intercity service provided on Peninsular Malaysia mainly by microwave radio relay; adequate intercity microwave radio relay network between Sabah and Sarawak via Brunei; domestic satellite system with 2 earth stations. *international:* country code - 60; submarine cables to India, Hong Kong, and Singapore; satellite earth stations - 2 Intelsat (1 Indian Ocean, 1 Pacific Ocean).
Maldives	*general assessment:* telephone services have improved; each island now has at least 1 public telephone, and there are mobile cellular networks with expanding subscribership. *domestic:* interatoll communication through microwave links; all inhabited islands and resorts are connected with telephone and fax service. *international:* country code - 960; satellite earth station - 3 Intelsat (Indian Ocean).
Mongolia	*general assessment:* network is improving with international direct dialing available in many areas. *domestic:* very low density of about 6 main lines per 100 persons (roughly 25 per 100 persons including cellular mobile phones); there are 3 wireless providers. *international:* country code - 976; satellite earth stations - 7.
Nepal	*general assessment:* poor telephone and telegraph service; fair radiotelephone communication service and mobile cellular telephone network.

	domestic: NA *international:* country code - 977; radiotelephone communications; microwave landline to India; satellite earth station - 1 Intelsat (Indian Ocean).
Oman	*general assessment:* modern system consisting of open-wire, microwave, and radiotelephone communication stations; limited coaxial cable. *domestic:* open-wire, microwave, radiotelephone communications, and a domestic satellite system with 8 earth stations. *international:* country code - 968; satellite earth stations - 2 Intelsat (Indian Ocean), 1 Arabsat.
Pakistan	*general assessment:* the telecom infrastructure is improving dramatically with foreign and domestic investments into fixed-line and mobile networks; mobile cellular subscribership has skyrocketed, approaching 50 million in late 2006, up from only about 300,000 in 2000; fiber systems are being constructed throughout the country to aid in network growth; main line availability has risen only marginally over the same period and there are still difficulties getting main line service to rural areas. *domestic:* microwave radio relay, coaxial cable, fiber-optic cable, cellular, and satellite networks. *international:* country code - 92; satellite earth stations - 3 Intelsat (1 Atlantic Ocean and 2 Indian Ocean); 3 operational international gateway exchanges (1 at Karachi and 2 at Islamabad); microwave radio relay to neighboring countries.
Philippines	*general assessment:* good international radiotelephone and submarine cable services; domestic and inter-island service adequate. *domestic:* domestic satellite system with 11 earth stations; cellular communications now dominate the industry with roughly 10 mobile cellular subscribers for every fixed-line subscriber. *international:* country code - 63; 11 international gateways; submarine cables to Hong Kong, Guam, Singapore, Taiwan, Japan, Brunei, and Malaysia among others.
Qatar	*general assessment:* modern system centered in Doha. *domestic:* NA *international:* country code - 974; tropospheric scatter to Bahrain; microwave radio relay to Saudi Arabia and UAE; submarine cable to Bahrain and UAE; satellite earth stations - 2 Intelsat (1 Atlantic Ocean and 1 Indian Ocean) and 1 Arabsat.
Russia	*general assessment:* the telephone system is experiencing significant changes; there are more than 1,000 companies licensed to offer communication services; access to digital lines has improved, particularly in urban centers; Internet and e-mail services are improving; Russia has made progress toward building the telecommunications infrastructure necessary for a market economy; the estimated number of mobile subscribers jumped from fewer than 1 million in 1998 to 120 million in 2005; a large demand for main line service remains unsatisfied, but fixed-line operators continue to grow their services. *domestic:* cross-country digital trunk lines run from Saint Petersburg to Khabarovsk, and from Moscow to Novorossiysk; the telephone systems in 60 regional capitals have

	modern digital infrastructures; cellular services, both analog and digital, are available in many areas; in rural areas, the telephone services are still outdated, inadequate, and low density. *international:* country code - 7; Russia is connected internationally by 3 undersea fiber-optic cables; digital switches in several cities provide more than 50,000 lines for international calls; satellite earth stations provide access to Intelsat, Intersputnik, Eutelsat, Inmarsat, and Orbita systems.
Saudi Arabia	*general assessment:* modern system. *domestic:* extensive microwave radio relay, coaxial cable, and fiber-optic cable systems. *international:* country code - 966; microwave radio relay to Bahrain, Jordan, Kuwait, Qatar, UAE, Yemen, and Sudan; coaxial cable to Kuwait and Jordan; submarine cable to Djibouti, Egypt and Bahrain; satellite earth stations - 5 Intelsat (3 Atlantic Ocean and 2 Indian Ocean), 1 Arabsat, and 1 Inmarsat (Indian Ocean region).
Singapore	*general assessment:* excellent service. *domestic:* excellent domestic facilities; launched 3G wireless service in February 2005. *international:* country code - 65; 9 submarine cables provide direct connection to more than 100 countries; satellite earth stations -4; supplemented by VSAT coverage.
Sri Lanka	*general assessment:* telephone services have improved significantly and are available in most parts of the country. *domestic:* national trunk network consists mostly of digital microwave radio relay; fiber-optic links now in use in Colombo area and 2 fixed wireless local loops have been installed; competition is strong in mobile cellular systems and mobile cellular subscribership is increasing; telephone density remains low. *international:* country code - 94; submarine cables to Indonesia, Djibouti, India and Maldives; satellite earth stations - 2 Intelsat (Indian Ocean).
Syria	*general assessment:* fair system currently undergoing significant improvement and digital upgrades, including fiber-optic technology. *domestic:* coaxial cable and microwave radio relay network. *international:* country code - 963; satellite earth stations - 1 Intelsat (Indian Ocean) and 1 Intersputnik (Atlantic Ocean region); 1 submarine cable; coaxial cable and microwave radio relay to Iraq, Jordan, Lebanon, and Turkey; participant in Medarabtel.
Taiwan	*general assessment:* provides telecommunications service for every business and private need. *domestic:* thoroughly modern; completely digitalized. *international:* country code - 886; satellite earth stations - 2 Intelsat (1 Pacific Ocean and 1 Indian Ocean); submarine cables to Japan (Okinawa), Philippines, Guam, Singapore, Hong Kong, Indonesia, Australia, Middle East, and Western Europe.
Tajikistan	*general assessment:* poorly developed and not well maintained; many towns are not linked to the national network.

	domestic: the domestic telecommunications network has historically been under funded and poorly maintained; main line availability has not changed significantly since 1998; cellular telephony is rare and coverage remains limited. *international:* country code - 992; linked by cable and microwave radio relay to other CIS republics and by leased connections to the Moscow international gateway switch; Dushanbe linked by Intelsat to international gateway switch in Ankara (Turkey); satellite earth stations - 1 Orbita and 2 Intelsat.
Thailand	*general assessment:* high quality system, especially in urban areas like Bangkok. *domestic:* fixed line system provided by both a government owned and commercial provider; wireless service expanding rapidly and outpacing fixed lines. *international:* country code - 66; satellite earth stations - 2 Intelsat (1 Indian Ocean, 1 Pacific Ocean); landing country for APCN submarine cable.
Turkey	*general assessment:* undergoing rapid modernization and expansion especially with cellular telephones. *domestic:* additional digital exchanges are permitting a rapid increase in subscribers; the construction of a network of technologically advanced intercity trunk lines, using both fiber-optic cable and digital microwave radio relay, is facilitating communication between urban centers; remote areas are reached by a domestic satellite system; the number of subscribers to mobile cellular telephone service is growing rapidly. *international:* country code - 90; international service is provided by 3 submarine fiber-optic cables in the Mediterranean and Black Seas, linking Turkey with Italy, Greece, Israel, Bulgaria, Romania, and Russia; satellite earth stations - 12 Intelsat; mobile satellite terminals - 328 in the Inmarsat and Eutelsat systems.
Turkmenistan	*general assessment:* poorly developed. *domestic:* Turkmenistan's telecommunications network remains woefully underdeveloped; Turkmentelekom, in cooperation with foreign investors, is planning to upgrade the country's telephone exchanges and install a new digital switching system. *international:* country code - 993; linked by cable and microwave radio relay to other CIS republics and to other countries by leased connections to the Moscow international gateway switch; a new telephone link from Ashgabat to Iran has been established; a new exchange in Ashgabat switches international traffic through Turkey via Intelsat; satellite earth stations - 1 Orbita and 1 Intelsat.
United Arab Emirates	*general assessment:* modern fiber-optic integrated services; digital network with rapidly growing use of mobile cellular telephones; key centers are Abu Dhabi and Dubai. *domestic:* microwave radio relay, fiber optic and coaxial cable. *international:* country code - 971; satellite earth stations - 3 Intelsat (1 Atlantic Ocean and 2 Indian Ocean) and 1 Arabsat; submarine cables to Qatar, Bahrain, India, and Pakistan; tropospheric scatter to Bahrain; microwave radio relay to Saudi Arabia.
Uzbekistan	*general assessment:* antiquated and inadequate; in serious need of modernization. *domestic:* the main line telecommunications system is dilapidated; the state-owned telecom company, Uzbektelecom, is using a US$110 million loan from the Japanese

	government to improve main line services; mobile services are growing swiftly, with the subscriber base doubling in 2005 to 1.1 million; there are 6 main cellular providers currently in operation. *international:* country code - 998; linked by landline or microwave radio relay with CIS member states and to other countries by leased connection via the Moscow international gateway switch; after the completion of the Uzbek link to the Trans-Asia-Europe (TAE) fiber-optic cable, Uzbekistan will be independent of Russian facilities for international communications.
Vietnam	*general assessment:* Vietnam is putting considerable effort into modernization and expansion of its telecommunication system, but its performance continues to lag behind that of its more modern neighbors. *domestic:* all provincial exchanges are digitalized and connected to Hanoi, Da Nang, and Ho Chi Minh City by fiber-optic cable or microwave radio relay networks; main lines have been substantially increased, and the use of mobile telephones is growing rapidly. *international:* country code - 84; satellite earth stations - 2 Intersputnik (Indian Ocean region).
Yemen	*general assessment:* since unification in 1990, efforts have been made to create a national telecommunications network. *domestic:* the national network consists of microwave radio relay, cable, tropospheric scatter, and GSM cellular mobile telephone systems. *international:* country code - 967; satellite earth stations - 3 Intelsat (2 Indian Ocean and 1 Atlantic Ocean), 1 Intersputnik (Atlantic Ocean region), and 2 Arabsat; microwave radio relay to Saudi Arabia and Djibouti.

Table C- 3 Telephone system in Asia