Consultation Paper

Unbundling of Access and Services

Pakistan Telecommunication Authority

Document classification	Paper for Public Consultation
Document version	Public_Consultation_150508
Filename	Unbundling
Version release date	15th May 2008
Present Subject	**Unbundling of Access and Services**

Version	**Date**	**Author**	**Changes to previous version**
01	03/03	Naseem Ahmed Vohra Consultant Technical PTA	Modifications incorporated after internal consultation
02	28/03	Naseem Ahmed Vohra Consultant Technical PTA	Released for Public Consultation on 15th May 08 after approval of the Authority

Table of Contents

Executive Summary

Unbundling, in telecommunications, refers to the obligations that regulators impose on the dominant operators to sell the functionalities of their network elements to new entrants; a facilitation to remove the entry barriers to data services market. Several forms of unbundling have been implemented over the years.

Unbundling, as a policy, is built on the recognition that incumbent operator has a dominant position in the provision of local communication access by virtue of its control over the local loop, an essential facility that cannot be economically replicated by alternative operators, more so in the face of much higher cost for laying copper cable as compared to other technologies which have invaded telecommunication market more recently.

The Federal Communications Commission (FCC) was the first regulator to obligate telecom operators in the US to unbundle their networks under the Telecommunication Act 1996 with the objective to promote competition in order to secure lower prices and higher quality services for consumers and encourage the deployment of new services.

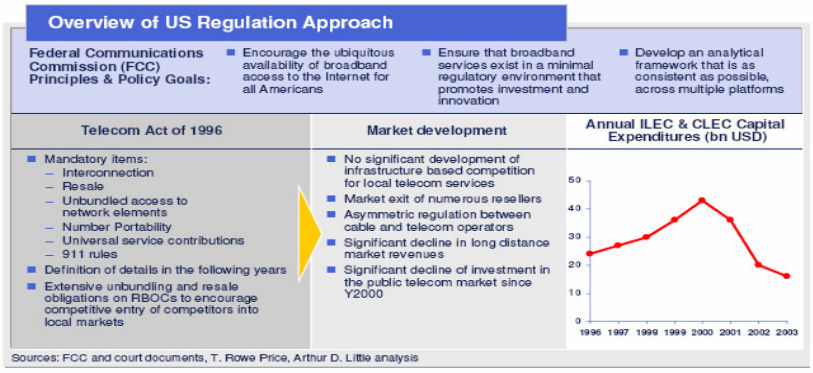
Under the ACT incumbent local exchange carriers (ILEC) were mandated to divide their traditional vertical hierarchy of telephone network into parts known as **Unbundled Network Elements (UNE)** and provide competing telecommunications carriers with access to these elemnets on unbundled basis to allow non facility based telecommunications providers to deliver service without laying network infrastructure, such as copper wire, optical fiber, and coaxial cable.

Such unbundled access allowed companies, such as cable television, wireless providers, and electric/gas utilities, who already had customers, installation and maintenance crews, and billing systems, to lease the network elements they were missing, such as voice switches, or electronic ordering systems, to complete their local telephone system.

Although FCC achieved some successes in increasing the market share of new entrants, UNE obligations led to a decline in infrastructure investments. The incumbents cut back on investments into their network because their investments were not protected from the new entrants. The new entrants, on the other hand, choose to rent facilities instead of incurring high capital investments.

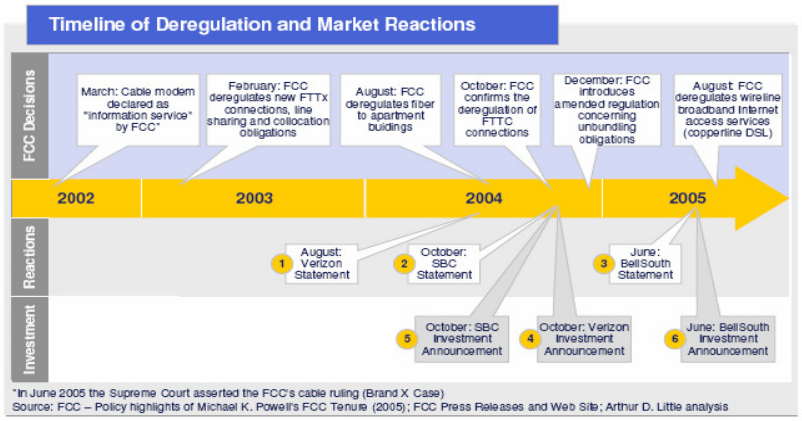
Following picture captures the unbundling mandated in the US under telecommunication Act 1996, the market response and the decline in infrastructure investment as a result thereof:

Unbundling led to decline in infrastructure investment in US



After a series of court cases and decision by D.C. Court in 2002, FCC released the Triennial Review Order in August 2003 which removed most of the unbundling obligations imposed on the ILECs. Line sharing was to be phased out over three years while local loop unbundling was retained as such and fiber deployment was fully exempted from unbundling. Following picture depicts steps taken by FCC to reverse unbundling obligations with time stamp:

Trendline of Unbundling and Market Reaction



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"Unbundling" after the Triennial Review Order was confined to local loop alone in the US, while European Union obligated unbundling of the local loop alone right from the start. Presently UNE is not mandated anywhere in the world.

As internet usage grew over the past decade broadband access demonstrated its relevance to economic growth of the country through knowledge based economy, the objective of LLU shifted from "enhancing competition in local telephony" to "growth of broadband".

Following forms of local loop unbundling have been adopted by most of the countries around the world:

1. Full Unbundling
2. Line Sharing and
3. Sub-Loop Unbundling(SLU)

Line sharing was adopted by the incumbent in Pakistan during the monopoly regime (year-2000) when PTCL signed an O & M contract with four private operators to start broadband services over its local loop which was authorized to all the ISP after deregulation of the sector. A number of procedure and prices (co-location, line rental, power, air conditioning etc) have evolved over the years as also the dispute resolution. Major part of the unbundling framework, as such, is already in place.

Sub Loop Unbundling (SLU) is subject to very strong economies of scale, which are much more significant than for Full Unbundling (Chart below). This contributes towards the difficulty of the business case for authorized alternate operators who are likely to have a lower market share than the incumbent. Further, sub loop unbundling is still in the nascent stages where products are being developed and tested but no commercial deployment by the new entrants is yet available. However deployment cost falls below full unbundling for the operator with major share of the market with the added advantage of possibilities to deliver bandwidth hungry offerings to its customers.

Full unbundling and line sharing is widely deployed across the globe. Bulk of broadband lines (65.88%) is supported by DSL, riding the unbundled local loop.

Broadband over cable (CATV) is the second most broadband connection getter mainly in the countries with the history of Cable TV i.e. USA, Canada, UK etc.

Bitstream Access, another form of unbundling, not generally considered part of local loop unbundling by operators, rather as an important transitory measure while they roll out their unbundled access and collocation. Majority of OECD countries have still not introduced bitstream access.

Alternatives to Unbundling

Technical and administrative problems in unbundling the local loop coupled with the attitude of the incumbent worldwide has impeded the progress compelling the new entrants to adopt alternate technologies.

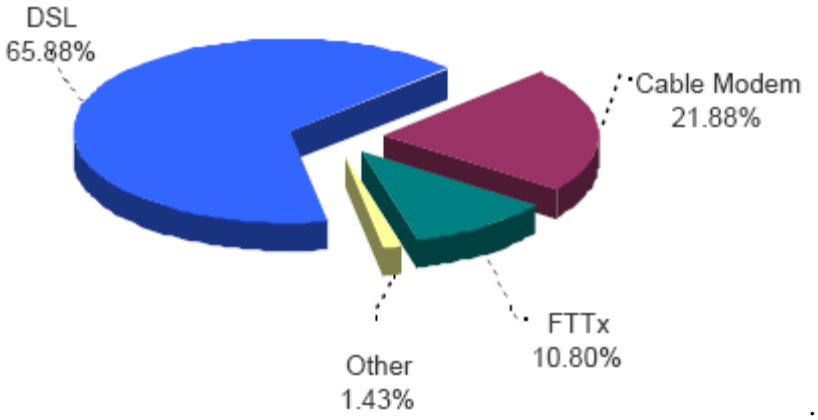
Quite a number of alternatives to unbundling have recently appeared on the telecom horizon such as optical fibre cable in local access network and broadband wireless access (Edge/3G, HSDPA, Wi Fi hotspots and most recently the WiMAX). Introduction of bandwidth hungry applications such as IPTV, VoD, video-gaming etc. over the broadband has catalyzed deployment of technologies capable of supporting such applications.

Optical fibre (FTTx) has started to out-perform DSL and cable modem in terms of growth quite recently. World FTTx subscriber base stood at 33.9million connections at the end of second quarter of 2007 with a year-on-year growth rate of 39.67 per cent, considerably more than DSL and Cable Modem during the same period. However in terms of overall broadband lines added, DSL far exceed the number of lines over FTTx in real terms

World Broadband Scenario

World broadband customer base stood at 313.6 million at the end of second quarter 2007 while the overall growth rate at 27.23% on annual basis. Second in line, cable modem had 21.88% share in the market while the customer base totaled 68.6 million during the same period. With only 10.80 per cent of the market share and a subscriber base of 33.8 million, FTTx supports a small customer base worldwide. All other technologies had a negligible share of 1.43%. FTTx however is the fastest growing technology with the potential to grab the biggest market share in the near future.

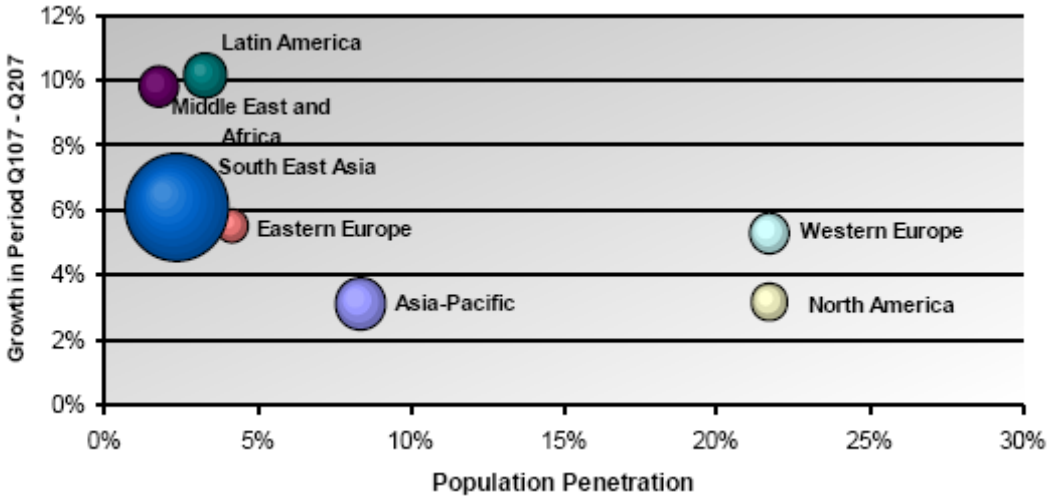
Worldwide Market Share by Technolgy



Growth Trends & Penetration

Eastern Europe experienced highest y-on-y growth (57.94%) followed by Latin America with growth rate 45.16%. Western Europe and North America far exceed all other regions in terms of population penetration, with identical penetration rates of 21.70 per cent by the second quarter of 2007 and a growth rate of 28.19% and 21.90% respectively. Following drawing depicts quarterly growth and penetration of each region separately.

Penetration & Quarterly Growth by Region



Whereas there were only 79040 broadband subscribers, all told, at the end of the previous fiscal year[1] which translates into 2.25% of the dial up internet subscriber is very small by any standards. However national broadband penetration is only 0.047%[2] as compared to India 3% and Malaysia 1%,

Technology Trends

Bulk of the worldwide broadband is supported by DSL followed by Cable Modem. FTTx at third position has started to pick up. A glance on the technology deployment in different regions around the globe, depicted in the table below, indicates the trends more vividly:

[1] PTA Annual report 2007

[2] Population taken is 165 Million

Broadband by Technology Q2 2007

Region	DSL	Cable Modem	FTTx
SE Asia	23.65	1.84	43.14
Asia Pacific	14.11	15.04	42.67
Latin America	5.42	5.78	-
North America	15.26	54.25	5.15
ME & Africa	3.22	1.01	
Western Europe	35.08	18.02	2.88
Eastern Europe	3.26	4.06	6.16

Share of DSL technology is the highest in Western European countries while lowest for FTTx whereas the equation is entirely opposite when we look closer to home i.e. Asia Pacific and South East Asia. Almost whole of FTTx deployment i.e. 85.81% of the world deployment is within this region and growth rate is fastest as compared to other technologies in the backdrop of diffusion of telecom and the entertainment.

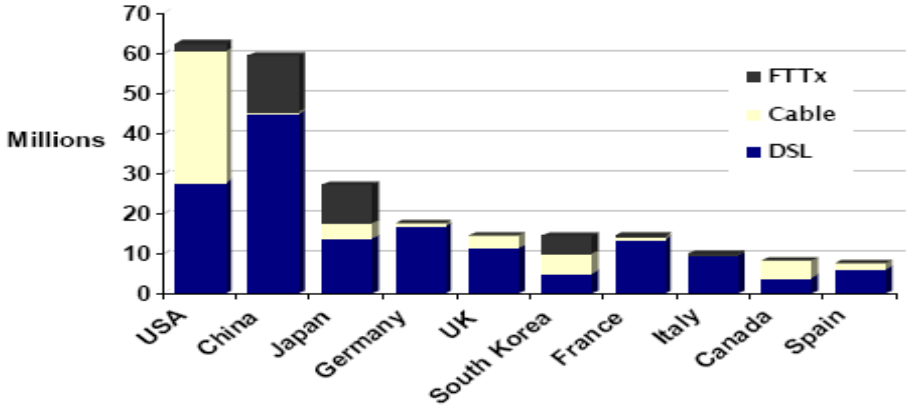
Most of the developed countries had a high fixed line penetration and the telecom markets already liberalized when internet hit the telecom markets of the world. With access to the customer already in place over the telephone line it was logical to benefit from the available infrastructure for high speed internet access hence development of DSL.

Cable Modem to hold the second place as technology of choice for provision of high speed internet are again similar, the access to the customer, high investment prone part already in place, offered the incentive in developing the technology to deliver the service using available infrastructure. North America with the history of CATV carries the cake with 54.25% share of the broadband deployment over cable modem across the globe.

Countries with less developed markets are more dependent on new technologies.

Following chart depicts the number of customers with underlying technologies of the top ten countries of the world with highest number of connections in the second quarter of 2007.

Total Subscriber Numbers by Technology Adopted

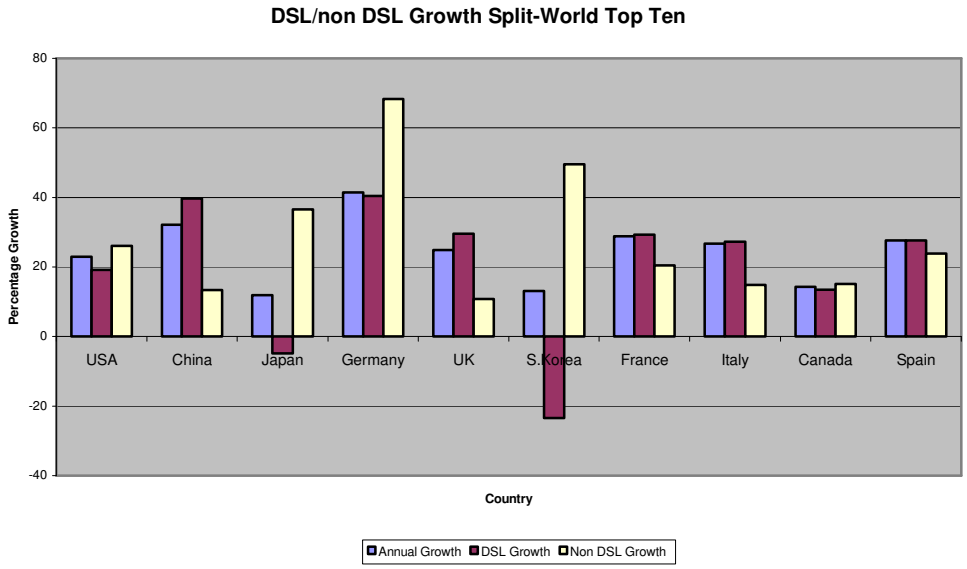


It is evident that DSL growth is still strong in the US and the European countries. US growth of non DSL lines is attributable to cable modem which still shows a strong growth. However DSL growth is pattering

out in Asian countries. Japan and South Korea, more recently China and quite a few other countries have joined them. The decline is attributed to FTTx.

It is obvious from the previous sections that FTTx is the technology of choice in Asia (South East & Asia Pacific) while cable modem in North America and DSL in Western Europe. FTTx, however is gaining grounds in Europe and North America while Latin America and ME & Africa are still depending on DSL & cable modem

FTTx deployment is strongest in the three Asian countries. FTTx subscribers represent 23.78 million and 30.86 per cent of the total subscriber bases in China, Japan and South Korea respectively while Japan and South Korea experienced negative growth in DSL on yearly basis as depicted in chart below. China has also joined them most recently.



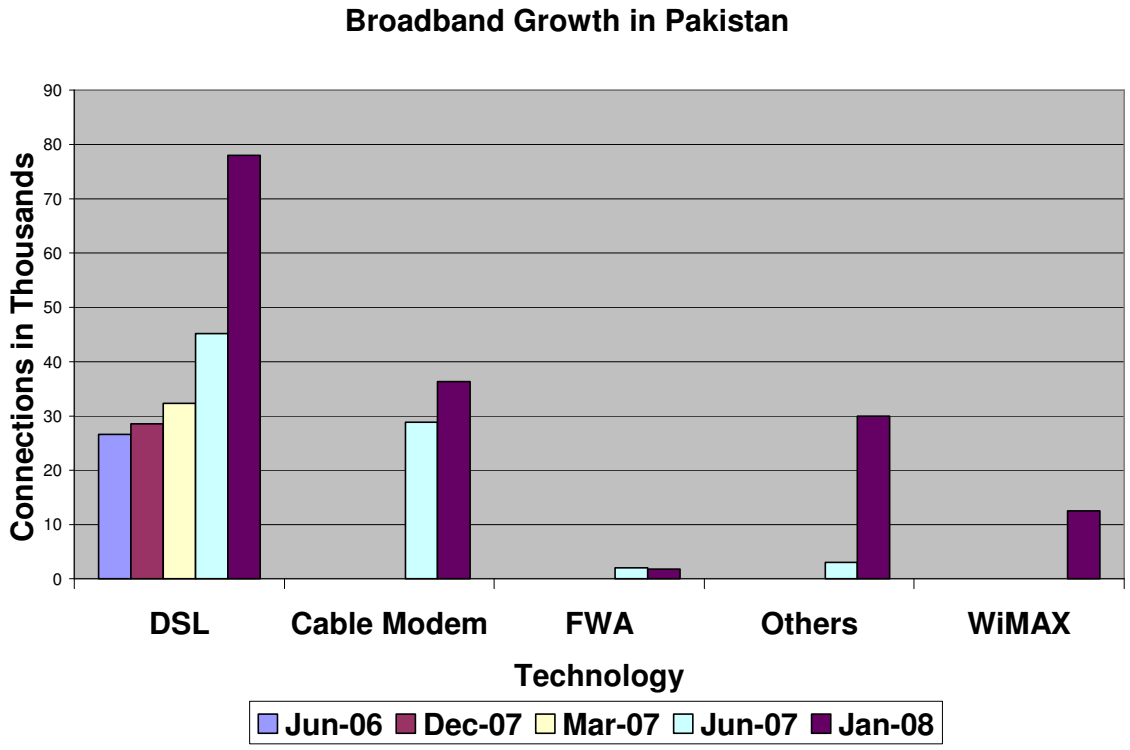
DSL, however still is the major underlying technology of the most countries particularly in Europe.

Local Broadband Market

Present Broadband policy in Pakistan lays all the emphasis on the promotion of e-commerce, e-governance while only line sharing is mandated to the incumbent for the provision of data services by the new entrants. Full unbundling is not mandated. Further voice is not allowed which is so very essential for the provision of a host of entertainment services which can attract the household user to opt for broadband services.

Total number of broadband connections has jumped from 45153 lines in June 2007 to 78033 in Jan 2008 at a growth rate of 42.21% over a period of seven months which is quite encouraging. Sudden surge in the broadband growth (30% in almost three quarters may be attributed to FTTx (broadband connection on optical fibre network recently commissioned by the incumbent).

WiMAX introduced, recently has picked up well with 12000 customers in one quarter while it is reported that an order for the supply of 198000 customer premises equipment has further been placed. It appears that broadband growth in Pakistan is gathering momentum despite very difficult conditions.



Others in the above chart represent "Desi Cable" i.e. broadband connection provided by the cable TV operators (over a separate coaxial cable) in collaboration with an ISP, mainly in Karachi city where small operators are providing service within high-rise apartment blocks where the customer can also download video of his choice.

To achieve higher national broadband penetration, it is imperative that home user spearheads the growth. Entertainment is the biggest demand driver for the home users where broadband is basic platform for the delivery of bundled services over the internet. The phenomena have resulted in making the home users, the biggest chunk of broadband subscribers in any society around the globe. For example overall broadband penetration in South Korea was 79% in 2006 whereas household penetration was 89%. Similarly the same figure was 38% against 56% household in France & 44% against 54% in Japan.

Policy on Broadband in Pakistan lays all the emphasis on e-commerce, e-governance etc. Further it does not allow voice over the internet stopping stand alone internet service providers to come up with offerings attracting the home user. Another key inhibitor to higher penetration rate for broadband is substantially high price, particularly for the home user. With the existing restrictions on the service providers, it is not possible to mitigate the higher price of broadband through blending of entertainment services for the customer to woo them even with a relatively higher price.

It is important to mandate full local loop unbundling, bitstream access and incumbent wholesale broadband lines at retail minus to open all avenues to generate a healthy competition and increase choice for the customers with possibility of value addition for the service providers add value for the residential market for the proliferation of broadband.

Policy on broadband needs an urgent review.

Conclusions

1. Unbundling (line sharing) is already in place since year 2000 It has brought taste of broadband however has failed in generating real competition

2. Present broadband market in Pakistan can be equated with mobile market before issuance of two additional mobile licenses

3. Competition needs to be generated through all possible means

4. Bundling of services has generated healthy competition and brought effective cost of broadband radically down in other countries

5. Household is the major catalyst in the spread of broadband, around the globe

6. Broadband policy revolves around e-commerce and e-governance alone, leaving the home user out of the loop

7. Internet with its long history could not transform Pakistan into a broadband society mainly due to:

    a. No possibility of value addition for home user

    b. Affordability

    c. Broadband policy

8. UNE, with associated implementation difficulties, was tried in North America and failed miserably. No other country tried the concept.

9. Bitstream Access was not mandated by most of the developed countries and left it to the market players to enter into contracts or otherwise.

10. Wholesale concept started off well at the start of unbundling, however, pattered out when the competition gained critical mass.

11. Sub Loop Unbundling is still in the product development stage and it is very early for Pakistan to opt for such unbundling at this stage; it may scare away investment in optical fibre access network.

12. Wireless solutions i.e. outdoor Wi Fi hotspots, WiMAX (mobile as well as fixed) appears a viable solution for its comparative ease to "roll out" coupled with "time to market", however, cost of the CPE is a major bottleneck. Efforts should be made to bring the cost of CPE down without any subsidies.

13. Cable Modem is the second major access technology although on the retreat; it still has great potential for our market.

14. DSL, presently, is the major underlying technology for broadband access, although on the decline in few countries of the world; it is the most viable solution at this point in time.

15. FTTx, though at the third place in terms of number of connection globally, has great potential to catch up with DSL- Cost of CPE coupled with roll out problems (right of way) has two major bottleneck for the time being.

16. Introduction of 3G in the local mobile market may further help proliferate broadband penetration, more specifically, in the business sector.

Recommendation

PTA concludes that full local loop unbundling is best option for broadband proliferation. However, to achieve positive results for this option it is important that retail unit is separated from the incumbent on the lines "Openreach" was created from BT. In the interim, Wholesale Bitstream Access to introduce competition at the retail level quickly without incurring too much cost coupled with wholesale bitstream with a sunset clause is the most suitable unbundling option. The sunset clause would be tied to the network rollout obligations of the new licensees. PTA can then review the need to extend the clause before the termination date of the sunset clause.

The pricing methodology for "copper" for full unbundling and bitstream access would be based on the LRIC model in line with other interconnection services. However, PTA recognizes that LRIC will take time to implement and therefore recommend a Retail Minus pricing method in the interim.

There is no need to differentiate unbundling policies based on geographical regions or business segments as there is no difference in the status of competition. Since bitstream access is closely tied to other interconnection service, PTA prefers that it be included in the RIO. This is in line with international best practice and also simplifies PTA's regulations.

To translate bulk of 3.5 million internet into broadband (78033-DSL) access through mandating following during Deregulation Policy review due this year:

1. Full local loop unbundling

2. Independent retail company for local loop

3. Mandating Wholesale

4. Value addition to Broadband for the service providers to offer attractive bundled services for household

I. Introduction

A. Purpose of this document

The purpose of this consultation paper is to examine unbundling options deployed around the globe for the promotion of broadband, evaluate them in the context of local telecom market and develop policy recommendations for unbundling of access and services in Pakistan, in consultation with the stakeholders.

B. Unbundling

Unbundling, in telecommunications, refers to the obligations that regulators impose on the dominant operator(s) to sell the functionalities of its network elements to new entrants. Unbundling may involve physical installation of the new entrants' equipments at incumbent's facilities (co-location) or leasing of network elements to new entrants.

Unbundling, is the obligation placed on the dominant operator to provide to any requesting telecom operator, for the provision of a telecommunications service to its customers, nondiscriminatory access to dominant operator's network elements on an unbundled basis at any technically feasible point on rates, terms, and conditions that are just, reasonable, and nondiscriminatory in accordance with the terms and conditions of the agreement under the reference unbundling offer (RUO). The incumbent operator is mandated to provide such unbundled network elements in a manner that allows requesting operators to combine such elements in order to provide such telecommunications service.

Unbundled access allows companies, such as cable television, wireless providers, and electric/gas utilities, who already have customers, installation and maintenance crews, and billing systems, to lease the network elements they are missing, such as a voice switches, or electronic ordering systems, to complete their local telephone system. Unbundling thus mandates that the traditional vertical hierarchy of the telephone industry be divided into parts, known as Unbundled Network Elements(UNE), so that new entrants can choose what they need to provide competitive local telecommunications service.

Unbundled network elements are the parts of the telecommunications network that the incumbent local exchange carriers are required to offer on an unbundled basis. Together, these parts make up a local loop that connects a digital subscriber line access multiplexer (DSLAM), a voice switch or both. The loop allows non-facilities-based telecommunications providers to deliver service without laying network infrastructure, such as copper wire, optical fiber, and coaxial cable.

C. Objectives of Unbundling

Unbundling has been implemented in many developed and some developing countries and the key objectives are twofold:

1. Developing high speed (Broadband) internet infrastructure and ensuring rapid growth of broadband customer base as a key foundation for the development of knowledge based economy

2. Provide level playing field for competition in the data retail market

D. Policy on Unbundling

Policy on unbundling is built on the recognition that incumbent operator has a dominant position in the provision of local communication access by virtue of its control over the local loop, which is normally considered an essential facility that cannot be economically replicated by alternative operators, more so, in the face of much higher cost for laying copper cable as compared to other technologies which have invaded telecommunication market more recently..

Under the 1996 Telecoms Act, FCC imposed the following conditions on the Incumbent Local Exchange Carriers (ILEC) to open their networks to the Competitive Local Exchange Carriers (CLEC) with the following Unbundled Network Elements (UNE):

1. Local loops
2. Network interface devices
3. Local and tandem switching
4. Inter-office transmission facilities
5. Signaling networks and call related databases
6. Operations support systems
7. Operator services and directory assistance

From these unbundled network elements, two principal unbundling models emerged.

a. Unbundled Network Elements-Platform (UNE-P) – CLEC leased the entire platform needed to provide services. This allows CLEC to enter a market without owning any facilities.

b. Unbundled Network Elements-Loop (UNE-L) – CLEC lease the local loops from the ILEC

Most European countries require unbundling only for local loops, whereas the US requires unbundling of other associated facilities. In Japan, in addition to local loops, there is also a requirement to unbundle splitters for DSL, routing transmission function, optical splitter and media converters for FTTH.

Although LLU began as a policy to promote competition in local telephony, recently it has received attention because of its role in stimulating broadband development in a number of countries and the possibility of diffusion of various telecom services over one neutral platform.

In theory, all major network elements can be considered for unbundling. Following network elements are normally considered for unbundling.

E. Network elements candidate for unbundling

Type	Local	Middle Mile	Trunk
Operational Support Systems (OSS)	• Network maintenance • Fault reporting • Traffic reporting • Call Detail Records • Billing		
Switches	• Local switches • Remote concentrators	• Data routers	• Tandem Switches • International gateways • Data routers

Type	Local	Middle Mile	Trunk
Network Interface Devices	• Local switch MDF • DDF • In building MDF • Street cabinets	• Main Distribution Frame (MDF) • Digital Distribution Frame (DDF)	• MDF • DDF
Transmission Devices	• DSL Access Multiplexers (DSLAM)	• Multiplexers	• Multiplexers
Transmission infrastructure	Local loops: • Copper • Fibre • Wireless • Cable Ducts • Poles • Towers	Middle mile: • Microwave • Fibre	Trunk: • Microwave • Fibre

F. Local Loop Unbundling

a) Background

Incumbent telecommunication operators have built their local networks over a long period in a monopoly framework. With the liberalization of telecommunication sector, new entrants found it extremely difficult to replicate the local networks and compete with incumbents. These difficulties included access to rights of way, the costs of network construction relative to revenue growth, and the difficulty of enticing customers, especially residential customers, to change access and service providers:

Incumbents during the monopoly era were considered as public utilities, and in many cases were government departments. As such they had little difficulty obtaining rights of way.

As monopolies, most incumbents used extensive cross-subsidies between services which provided revenue flows to investment in local infrastructure. These cross-subsidies have in many cases not been completely eliminated so that local subscriber lines may still be priced under cost in a number of countries.

Residential customers tend to be static with respect to changing their fixed subscriber provider relative to staying with the existing service provider while opting for long distance service from the new entrants (carrier selection).

The history of facilities-based competition, especially in the local access market, has shown how difficult it is to compete for customers in this market. In OECD countries with the longest history of local competition, new entrants have captured a relatively small part of the subscriber base. In the United States new entrants have managed to attain a market share of 9.0% of the local subscriber market since 1984, in the United Kingdom the share of new entrants for residential lines since the end of the duopoly in 1984 is 19%, and in Japan, where the market was in principle opened in 1985, the share of new entrants is 18.5%.

Initially, the challenge to create local loop competition did not lead most regulators to use local loop unbundling as a policy option. Some regulators argued that unbundling would reduce incentives by new entrants to invest in network infrastructure thus slowing down the availability of alternate PSTN

infrastructure and local competition. Other regulators immediately implemented unbundling once local telecommunication markets were opened to competition, but did not follow through with supporting policies (collocation, interconnection, price rebalancing) such cases proved that unbundling alone was not sufficient to create effective competition.

The emergence of Internet services highlighted the importance of local loop for the provision of Internet service to the customer. Internet service providers have to depend on local network providers for access to customers. With the emergence of high-speed Internet access (broadband) based on the public switched telecommunication network – mainly asymmetric digital subscriber line technology (ADSL) – the question of access to local network infrastructures has moved to the forefront of policy agendas. ADSL technology converts pairs of copper wire telephone lines into high-speed digital lines.

Although the main focus of LLU is the public switched telecommunication network, unbundling can be applied to fibre optic networks and a form of unbundling (shared access) could be applied to cable television networks. The issue of open access to CATV infrastructure to offer high-speed Internet is important but not supported by all regulators.

The type of unbundling required by a new entrant is a function of the services being offered and influenced by technical issues, such as MDF size and availability of collocation space. The application of LLU varies across countries. For example, in the US network unbundling includes sub-loops, switching, and operations support systems (OSS), whereas European countries basically focus on local loop. .

European Council issued regulation on unbundling (EC/2887/2000) that came into force in January 2001. This regulation focused on local loop only and was adopted throughout the European Union.

b) Types of Local Loop Unbundling

Local loop refers to the telecom circuit, usually pairs of copper wire between the user's premises and telecom operator's main distribution frame (MDF) According to OECD, Local Loop Unbundling refers to the process in which incumbent leases wholly or in part the local segment of its telecommunications network to competitors.

Ofcom defines local loop unbundling as the process by which an alternative operator is able to provide fixed line and DSL broadband services over the twisted copper pair "local loop" which connects a consumer premises to BT local exchange.

In general, there are three types of LLU:

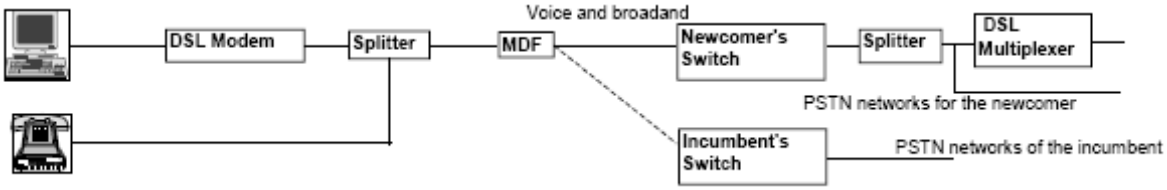
1. Full unbundling (or access to copper).

2. Line sharing or shared access.

3. Bitstream access

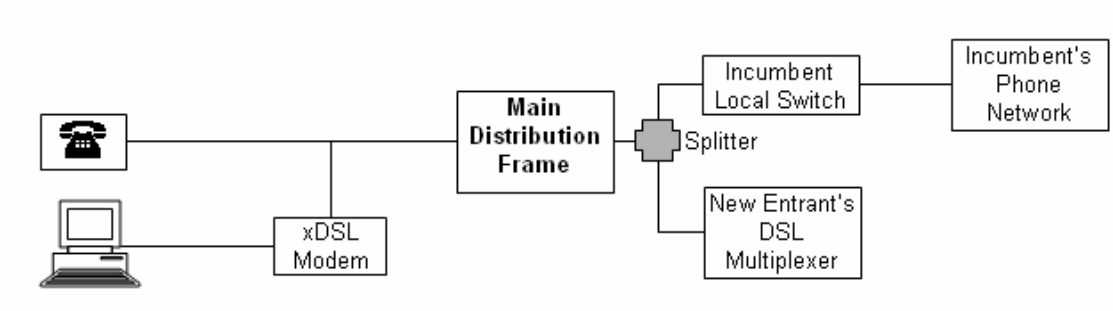
(1) Full Unbundled Access

Full unbundled access refers to the situation when a new entrant leases the copper pairs from the incumbent. The new entrant takes control of the copper pairs and can provide both voice and data services over all frequencies supported by the copper pairs. The incumbent still retains ownership of the unbundled copper pairs and is responsible for its maintenance.



(2) Line Sharing

Line sharing refers to sharing of the loop by the incumbent itself (for voice) and the new entrant for provision of ADSL services. The incumbent still controls the voice frequency and continues to provide voice services to the subscriber. Following drawing depicts exact arrangement:



Line sharing allows the incumbent to continue to provide telephone service while the competitor provides broadband (xDSL) services on the same copper pair. With line sharing, the competing supplier uses the non-voice frequency of the loop. Consumers can obtain broadband service from the most competitive provider without installing a second line.

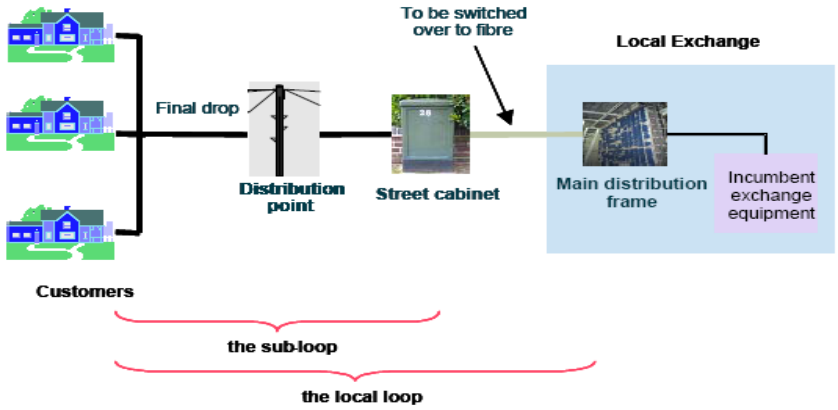
A primary difficulty of line sharing has to do with technical interface problems. For example, implementation of ADSL with telephony and with ISDN uses different spectrum allocation so that different equipment may be necessary both for the splitter and for ADSL. In addition, line sharing may slow down the speed for digital access in general due to "frequency unbundling". When high-speed data runs along adjacent telephone lines, the signal on one wire can bring noise into the next wire, interfering with the signal and resulting in slower data rates. This problem is known as "crosstalk", which has to be technically overcome in order to expand ADSL access via line sharing.

(3) Sub Loop Unbundling

Sub Loop Unbundling refers to the partial unbundling of the local loop between the MDF and the termination points at the client premises. There are a few logical points within the local loops that are suitable for sub-loop unbundling but the most common form of Sub Loop Unbundling is to set the connection points at the Outdoor Cabinet. Sub Loop Unbundling can be used for emerging technologies such as VDSL (Very-High-Data-Rate Digital Subscriber Line) which can deliver bandwidth of up to 52 Mbps, but requires the access equipment to be much closer to the end users.

Part of the local loop between the street cabinet and the local exchange (which is the point of interconnection with the incumbent's core network) is switched over to fibre, as shown in the figure below:

Typical FTTC/VDSL network architecture



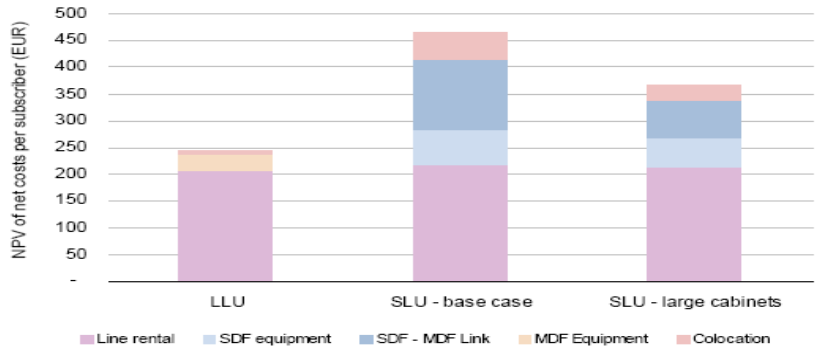
Source: Analysis

Elements in Sub Loop Unbundling

At present there are no commercial deployments of SLU in the world, although interest is starting to increase as incumbent operators begin to deploy VDSL. The incumbents in the Netherlands and Germany both have extensive VDSL plans. In the former case, OPTA has already considered the competitive implications of SLU, though in Germany the situation is more complex due to Deutsche Telkom stance on unbundling. In the UK, the first deployment of VDSL is expected to be in South Yorkshire, in an initiative supported by public funds. It is anticipated that SLU will be used in this initiative, and it may therefore be an important learning ground for operators and regulator alike. At this point, however, the timing of any roll-out is not clear.

Irish regulator hired services of M/S Analysys to examine Irish market for SLU deployment. The study revealed that the solution was not particularly viable for new entrants who may entice very few customers at cabinet level which makes a very poor business case in face of substantial investments. Following chart depicts the whole picture:

Relative net costs for LLU, SLU, and SLU targeted at large cabinets only



Source: Analysys

The costs in the base case below, referred to as the 'NPV of net costs per subscriber', are equal to the NPV of costs, minus the NPV of additional revenue, divided by the NPV of subscribers, and represent an average cost per line. The additional revenue for SLU has been allocated across the other cost categories in proportion. The base case makes the following key assumptions:

• the modeled operator offers voice and broadband services

• the penetration of broadband in Ireland reaches 65% by 2017

• compared to LLU, the other authorized operator achieves an increase in average revenue per line (ARPL) of EUR5 per month (after VAT) by 2014

• the operator rolls out SLU to all street cabinets in the Dublin area

• it gains a 30% share of the broadband market in the areas where it rolls out services

• backhaul links to the MDFs are rented from eircom

• the OAO is co-located with eircom at each cabinet.

Irish telecom regulator appointed M/S Analysis Consulting Ltd, to undertake a study to understand the viability of providers using eircom, the Irish incumbent, fibre network through sub-loop unbundling in the Dublin area.

Modeling exercise run by Analysys in Dec 2007 showed that under a base case believed to represent the most likely market scenario – SLU is not as commercially attractive as LLU. This is also the case if competing licensed operators were to focus their roll-out on the larger cabinets (those with more than 300 lines per cabinet).

A Sub Loop Industry Coordination Group has been created in UK. The group's purpose is to develop the sub loop product to be fit for purpose. The committee has recently announced a range of sub loop products for the creation of a realistic trial that will test the complete product, its supporting processes and technical capabilities.

Progress in LLU in developed countries has mostly relied on:

- Extent to which incumbents have opened up their local loop and up-graded their collocation facilities for the installation of equipment by the new entrants

- Achievement of consensus on collocation procedures and pricing thereof

- Availability of collocation space in exchanges where most of the new entrants want space at the same time and the way the space is allocated to the access seekers

- Pace at which regulators have taken action to help open local loop by the incumbent and solved collocation problems i.e. space, pricing etc

- Extent to which rebalancing of subscriber line prices has been undertaken in the past to make sure that there is no price squeeze on new entrants.

Progress in LLU is constrained by its technical complexity and active involvement by the regulator in the process leading to opening up the local loop. New entrants have to take a number of steps such as pre-ordering, ordering, cut-over, and fault reporting in tandem with the incumbent for the implementation of local loop unbundling. Further the problem in reaching agreement on pricing of the LLU between the incumbent and the access seekers has resulted in delaying the process.

1. The majority of countries consider that LLU has the potential to enhance local competition and assist in the development of competition for broadband services as well as in its diffusion. From this perspective, implementation of LLU is expected to benefit consumers by reducing not only local telephony but also broadband Internet access costs and accelerating the supply of new services.

2. Continued regulatory intervention would be necessary where the implementation of LLU has not yet been successful because of the imbalance in negotiating power between the incumbents and new entrants.

3. LLU requires operational co-ordination between the incumbent and new entrants regarding such processes as ordering, provisioning, billing, fault handling and service-level agreements.

4. Agreement is also required in areas such as pricing, collocation and spectrum management on broadband local loops. Operational co-ordination and other agreements can be facilitated through self-regulatory frameworks or detailed intervention by regulators. The role of the regulator in arbitration remains essential.

5. Relatively low monthly rental charges have facilitated implementation of local loop unbundling in some countries, such as Denmark and Sweden while other countries, such as Ireland and the United Kingdom, have made slow progress due to relatively high charges for unbundled loops.

6. A major element of success of unbundling is linked to the relationship between the price of the subscriber line to the end-user and the cost of unbundling for the new entrant. The former should necessarily be higher than the latter in order to allow new entrants to invest profitably in LLU. This involves the requirement to make an adequate rebalancing on the price of the subscriber line.

7. It is important to note that LLU cannot address all the issues involved in relation to broadband market competition. There are many other ways of achieving the goals for a broadband society. Primarily, the target technology for LLU would be asymmetric digital subscriber lines (ADSL) via the fixed telephone network. However, deployment of alternative technologies, such as wireless local loops, cable, fibre, satellite and Ethernet, is also important, and this may also help reduce the relative importance of LLU in the future.

Most of the time, the regulator has to find a balance between the right of the incumbents to manage their own infrastructure and the desire of new entrants for access to the facilities of the incumbent. Progress in the implementation of LLU differs extensively across the globe. For example, the United States has the longest history of LLU, and the number of unbundled local loops that the incumbents reported providing to other carriers reached approximately 9.4 million or 5.5% of incumbent local exchange carrier (ILEC) total lines by December 2001[3]. In Japan, the number of unbundled local loops was approximately 4.2 million, equivalent to 8.25% of total lines by the end of February 2002. On the other hand, some other countries, such as Mexico, the Slovak Republic and Turkey had not taken initiatives for LLU implementation.

[3] Unbundled loops include both unbundling and line sharing, but not bitstream access

G. Bit stream access

Bit Stream Access refers to the situation where a wireline incumbent installs a high speed access link to the customers premises (e.g., by installing ADSL equipment in the local access network) and then makes this access link available to third parties, to enable them to provide high speed services to customers. This type of access does not entail any third party access to the copper pair in the local loop.

The incumbent may also provide transmission services to its competitors, using its ATM or IP network, to carry competitors' traffic from the DSLAM to a higher level in the network hierarchy where new entrants may already have a point of presence (e.g. a transit switch location). Bit-stream handover points thus can be at IP level, ATM-Pop or DSLAM level.

Bit Stream Access is considered a key tool for opening competition in the broadband market. It enables competitors to offer their own products to consumers even if they do not operate the local loop (the last mile). Bit stream access allows the new entrant to use the high-speed modems and other equipment provided by the incumbent and thus avoid maintenance and investments into the local loop. This affects the economics of the service and places restrictions on the type of modems that the customer of the new entrant can buy or rent.

The main elements defining Bit Stream Access are the following:

- High speed access link to the customer premises (end user part) provided by the incumbent and transmission capacity for broadband data in both direction enabling new entrants to offer their own, value-added services to end users;

- New entrants have the possibility to differentiate their services by altering technical characteristics and/or the use of their own network;

- Bit Stream Access is a wholesale product consisting of the access (typically ADSL) and “backhaul” services of the (data) backbone network (ATM, IP backbone).

Bitstream access provides new entrants with a wholesale xDSL product from the incumbent. With bitstream access, the incumbent maintains control over the subscriber’s line but allocates spectrum to an access seeker. The incumbent provides the ADSL technology and modems so that new entrants have no management control over the physical line and are not allowed to add other equipment.

Unlike full unbundling and line sharing, the access seekers can only supply the services that the incumbent designates. Accordingly, bitstream access reduces the level of competition compared with full unbundling and line sharing as there is no competition at the physical layer and there is no incentive for the incumbent to deploy new technology. For new entrants, a low level of service-based competition can be expected due to the fact that they can only obtain access to the system that the incumbent chooses to implement.

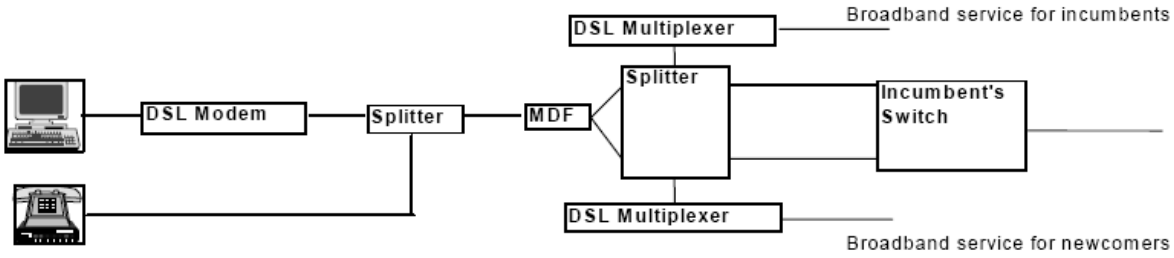
With bitstream access, spectrum management between operators is unnecessary because it is handled completely by the incumbent. It is partly for this reason that new entrants generally do not favor this method.

This variant of unbundling can be a good option, especially for ISPs. While bitstream access has been considered as a form of unbundling, there are some countries that do not view bitstream access falls within the scope of unbundling policy.

There are also a number of countries that have not introduced this form of access at all.

Bitstream access can lead to line interference in specific situations depending on the xDSL technology used. For example, in the case of simultaneous use of xDSL technology by more than one operator, there may be difficulties in operating at the same time. In such a case it is difficult to identify the ultimate source of disturbances.

Bitstream Access



Thus, Bit Stream Access is a wholesale product consisting of the access (typically ADSL) and "backhaul" services of the (data) backbone network (ATM, IP backbone).

E.U. Regulation

Unlike Local Loop Unbundling, the provision of Bit Stream Access services is not mandated under European Community law, but where an incumbent operator provides Bit Stream DSL services to its own subsidiary or third party, then, in accordance with Community law, it must also provide such forms of access under transparent and non-discriminatory terms or conditions to others (Directive 98/10/EC Article 16).

Note: Bit Stream Access service allows the incumbent to retain control of the rate of deployment of high speed access services, and the geographical regions in which these service are rolled out. From the regulatory point of view, such services are therefore seen as complementing the other forms of unbundled access, but not substituting them.

Wholesale Bitstream Access

Wholesale bitstream access is technically not unbundling. It does not require co-location of the new entrants' equipments at the incumbent's facilities or sharing of network elements. However, it needs to be considered alongside other unbundling options since it is an alternative mean for new entrants to offer retail services to end users.

For wholesale bitstream access**,** new entrants have their own data networks but have no 'last mile' access to the end user. The incumbent therefore sells the capacity to carry the bitstream from the end users' premises to the new entrants' data networks.

Stepping stone for new entrants

For many regulators, unbundling was the stepping stone for new entrants to gain market share as they build their own networks. Mandatory unbundling of the incumbents' network elements allowed the new entrants to derive revenue from offering services over the unbundled network and use this revenue to construct their own networks.

II. Alternatives to Unbundling

Over the past decade, many vendors of Wireless Local Loop systems have enhanced their systems to include broadband wireless access solutions. Uptake of these systems to date has been limited, in part, for wide variety of proprietary technologies.

Recent emergence of near-standard broadband wireless access systems such as fixed BWA WiMAX (802.16a-2004), and mobility BWA solutions such as IP Wireless, WiBro and WiMAX (802.16e) has led to increased interest in the use of these technologies as alternative 'last mile' solutions. With potential ranges between 2km (urban), up to 10 km (suburban), and about 50 km (rural) in selected cases, such systems may prove to be both economical and faster to deploy than traditional copper or fiber solutions.

With rapid technological developments in the telecommunications sector, it is important to consider the impact of new technologies that may render unbundling irrelevant. Since unbundling is focused on the data market, we pay special attention to alternative local loop technologies for data. The technologies to consider are:

1. Broadband Wireless Access (BWA)

Broadband wireless access enables internet access for mobile devices such as laptops and mobile phones, both at fixed locations and on the move. Since the turn of the century, mobile operators have undertaken a variety of upgrades to their networks, adding not just 3G but a host of other network enhancements. With the deployment of the latest technologies (HSDPA and HSUPA), mobile operators are beginning to compete head-to-head with fixed operators for a slice of the broadband market.

Wireless data networks exist in such number and variety as to be difficult to categorize and compare. Some wireless data networks run over wireless voice networks, such as mobile telephone networks. CPDP, HSCSD, PDC-P, and GPRS are examples. Other wireless networks run on their own physical layer networks, utilizing anything from antennas built into handlheld devices to large antennas mounted on towers. 802.11, LMDS, and MMDS are examples. A few wireless networks are intended only to connect small devices over short distances. Bluetooth is an example.

Wireless networks which run over other wireless networks often utilize the lower layer networks to provide security and encryption. Stand-alone wireless networks either provide their own security and encryption features or rely upon VPN (Virtual Private Networks) to provide those features. In many cases, multiple layers of security and encryption may be desirable.

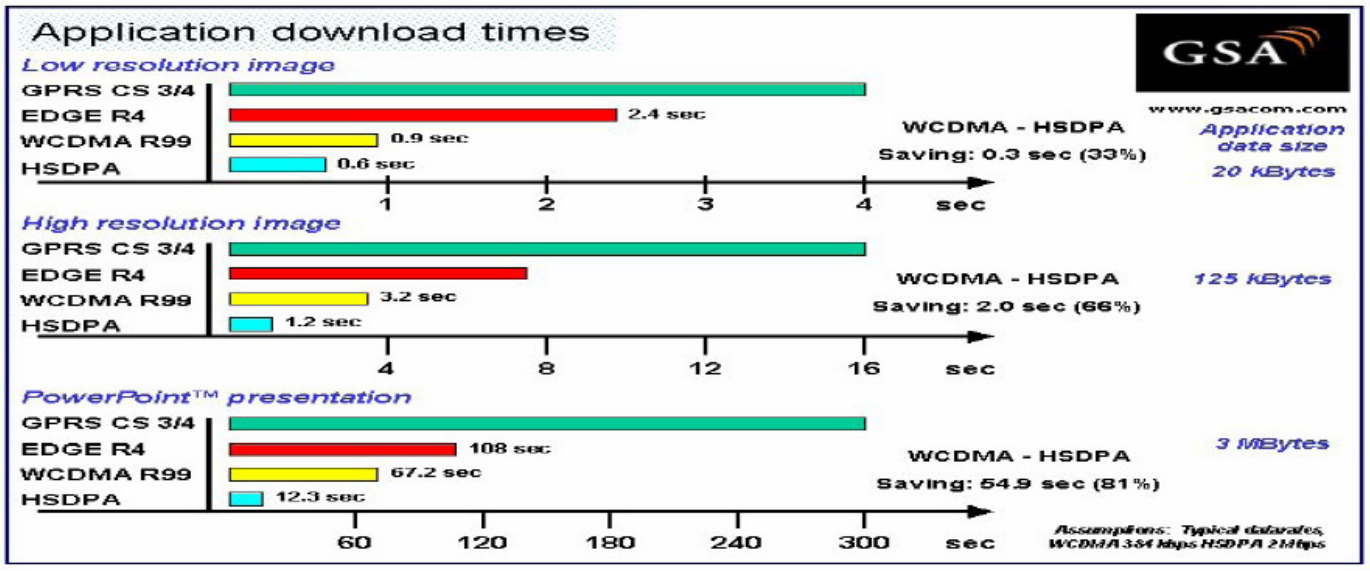
Some wireless networks are fixed, meaning that antennas do not move frequently. Other wireless networks are mobile, meaning that the antenna can move constantly. This is sometimes a feature of the specific implementation and antenna design, instead of an inherent limitation of the wireless network specification. Wireless networks may operate on licensed or unlicensed portions of the frequency spectrum

Mobile Broadband

Mobile broadband in its simplest terms refers to the ability to access the internet from a variety of mobile devices such as laptops, PDAs, Blackberrys and Smartphones. It describes the use of 3G services using the most recent additions on the mobile technology evolutionary path, HSDPA (High Speed Downlink Packet Access) and HSUPA (High Speed Uplink Packet Access), both of which belong to the High-Speed Packet Access (HSPA) family. HSPA, with its origins in the GSM family, is a collection of mobile telephony protocols that have improved upon the existing Universal Mobile Telecommunications System (UMTS) protocols. It is predominantly an upgrade to the existing network infrastructure which enables faster data rates, typically associated with fixed line DSL, to mobile users. HSDPA enables a user to receive large

files to a mobile device such as email attachments, web pages, plus a host of multimedia entertainment services. The chart below provides a sample of estimated download times for a range of files and applications using different mobile network technology standards.

Figure 6.1 GSA – Example of Application download times



Currently, maximum speeds achieved by HSDPA are 14.4Mb/s but most network operators provide speeds of up to 3.6Mb/s with the rollout of 7.2Mbps quickly growing. However, further speed increases are planned in 2008 with networks being upgraded to Evolved HSPA or HSPA+ which will provide speeds of 42Mb/s and further down the evolutionary path - HSOPA, a technology currently under development, aims to achieve data rates of up to 200Mb/s for downlink and 100Mb/s for uplink.

MMDS

Multichannel multipoint distribution service, also known as MMDS or Wireless Cable, is a wireless telecommunications technology, used for general-purpose broadband networking or, more commonly, as an alternative method of cable television programming reception. MMDS is used in the many countries for example United States, Canada, Mexico, Dominican Republic, Iceland, Ireland, Brazil, Barbados, Australia, Nigeria, Sri Lanka, Thailand, Uruguay and India including Pakistan. It is most commonly used in sparsely populated rural areas, where laying cables is not economically viable, although some companies may also offer MDS services in urban areas.

The MMDS band uses microwave frequencies from 2 GHz to 3 GHz in range. Reception of MMDS-delivered television signals is done with a special rooftop microwave antenna and a set-top box for the television receiving the signals. The antenna usually has an integrated down-converter to transmit the signals at frequencies compatible with terrestrial TV tuners down on the coax (much like on satellite dishes where the signals are converted down to frequencies more compatible with standard TV coaxial cabling), some larger antennas utilise an external down-converter. The receiver box is very similar in appearance to an analog cable television receiver box.

The MMDS band is separated into eleven "channels" which are auctioned off like other bands. The idea was that entities could own several channels and multiplex several television and radio channels onto each channel using digital technology. Each "channel" was capable of 10 Mbit/s, exclusive of any forward error correction technology that is required for this type of technology.

MMDS and DOCSIS+

LMDS and MMDS have adapted the DOCSIS (Data Over Cable Service Interface Specification) from the cable modem world. The version of DOCSIS modified for wireless broadband is known as DOCSIS+.

Data-transport security is accomplished under MMDS by encrypting traffic flows between the broadband wireless modem and the WMTS (Wireless Modem Termination System) located in the base station of the provider's network using Triple DES.

DOCSIS+ reduces theft-of-service vulnerabilities under MMDS by requiring that the WMTS enforce encryption, and by employing an authenticated client/server key-management protocol in which the WMTS controls distribution of keying material to broadband wireless modems.

LMDS and MMDS wireless modems utilize the DOCSIS+ key-management protocol to obtain authorization and traffic encryption material from a WMTS, and to support periodic reauthorization and key refresh. The key-management protocol uses X.509 digital certificates, RSA public key encryption, and Triple DES encryption to secure key exchanges between the wireless modem and the WMTS.

MMDS provides significantly greater range than LMDS, it however may be obsolete with the introduction of 802.16 WiMAX standard.

MMDS is sometimes expanded to Multipoint Microwave Distribution System or Multi-channel Multi-point Distribution System. All three phrases refer to the same technology. MMDS Parabolic antenna

In the United States WATCH TV (based in Lima, OH), Eagle Vision (based in Kirksville, MO), and several other companies offer MMDS based wireless cable television, internet access, and IP based telephone services.

In certain areas, MMDS is being deployed for use as wireless high-speed internet access, mostly in rural areas where other types of high-speed internet are either unavailable (such as cable or DSL) or prohibitively expensive (such as satellite internet). In Canada, Look Communications offers digital television and wireless bi-directional high speed internet from its MMDS transmitters situated in Ontario and Quebec. Range can be up to 25 km from transmitting towers for its bi-directional internet service. They offer 3 Mbit/s for download (from tower) modulated in QAM and 200kbit/s for upload (from the tower installed in the home) modulated in QPSK. Similar companies are providing MMDS wireless internet in the United States as well, with CommSpeed being a major vendor in the US market for MMDS-based internet.

In Ireland, Chorus and NTL Ireland both offer separate MMDS services in many regions. Chorus still broadcast 11-channel analogue MMDS in some areas, though with their recent acquisition by Liberty Global Europe (along with NTL Ireland), it is quite likely their systems will be merged and after suitable upgrading the analogue services will be dropped and be replaced by the DVB-C systems used elsewhere.

In Iceland, 365 Broadcast Media offers digital MMDS television services using DVB-T technology alongside a few analog channels.

Sun TV in Pakistan is offering TV service over MMDS

Common Wireless Network Types

Major types of wireless networks include:

CDPD	**Cellular Digital Packet Data**
HSCSD	**High Speed Circuit Switched Data**
PDC-P	**Packet Data Cellular**
GPRS	**General Packet Radio Service**
1xRTT	**1x Radio Transmission Technology**
Bluetooth	
IrDA	
MMDS	**Multichannel Multipoint Distribution Service**
LMDS	**Local Multipoint Distribution Service**
WiMAX	**Worldwide Interoperability for Microwave Access**
802.11	**Wi-Fi**

2. 3G Data Services

The theoretical data bandwidth of 3G networks can match current wired broadband technologies such as DSL. Figure below illustrates the theoretical speed of some 3G technologies.

Peak data rates for different technologies

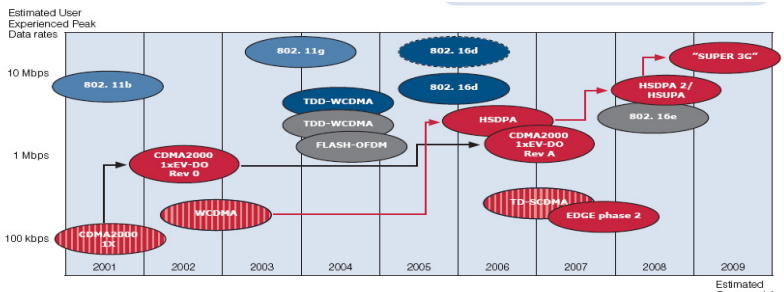


Figure 10. Comparison of radio access technologies with respect to coordinated availability, data throughput, level of mobility, reach, line-of-sight characteristics and application. Source: Northstream

Source: Northstream

While mobile data rates appear adequate, Figure above shows total data throughput available from each base station, and thus shared between all data users in the area. It can prove a bottleneck in the face of simultaneous use by a number of customers in the area. In addition, these mobile wireless services have some significant limitations which prevent them from being a viable alternative for unbundling in the near future.

3. High Speed Packet Access

The key issue is that the cost of rolling out these services is still much higher than traditional wireline broadband technologies and other wireless technologies. There are also some technical issues that have yet to be resolved such as reduced download speed as range increases, poor uplink speeds, and data latency. However technological improvement in the systems has encouraged many operators to deploy HSDPA over their 3G system. More and more 3G operators are upgrading their systems to deploy HSDPA to achieve.

High-Speed Downlink Packet Access (HSDPA) is an upgrade to a WCDMA 3G network that enables an increase in peak download speeds from 384kbit/s to between 1.6Mbit/s or 3.6Mbit/s (and up to 14.4Mbit/s in the future), thereby enabling mobile operators to offer download speeds comparable to those typically experienced by residential broadband consumers. T-Mobile was the first UK operator to launch HSDPA services over its 3G network in August 2006, with the four other operators all having followed by July 2007. With limited availability of compatible handsets, HSDPA is currently primarily targeted at business users using PC data cards.

4. Wi Fi Hotspots

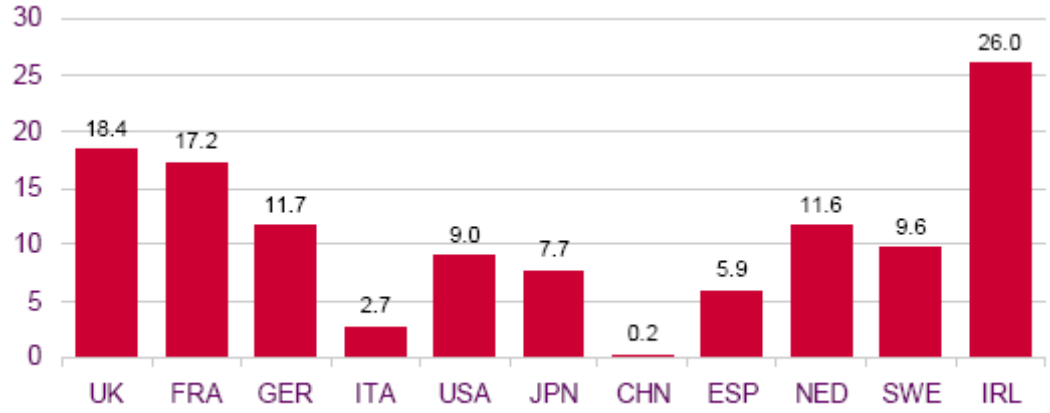
With consumers, in developed countries, increasingly using home wireless networks to access broadband internet in the home, and 3G mobile phones to access the internet elsewhere, recent times have seen fixed and mobile operators invest in infrastructure, handsets and propositions designed to provide data services outside the home, and bridge the consumer experience inside and outside the home.

UK maintains the position of a European country with most wireless ‘hotspots” and 12 UK cities now have sizeable ‘joined up’ wireless zones. Meanwhile, a number of initiatives by fixed-line operators, mobile providers and start-up WiFi network operators for example “The Cloud”, with municipal support at times, have increased the number of public WiFi access points to 11,447 (at the end of March 2007, compared to 10,339 a year previously)..

WiFi networks potentially provide an alternative to fixed-line broadband access in highly populated areas, but the limited range of WiFi networks makes them impractical for wide geographical coverage. WiMAX technology offers longer-range coverage and in the long term represents a potential alternative to cellular networks for geographically-spread wireless broadband.

Following chart depicts a few countries where hotspots are deployed.

Public wireless hotspots per 100,000 population, Q4 2006



Source: Informa

Wi-Fi-enabled cellular handsets represent a way of integrating home and public wireless networks with cellular networks, enabling customers to make VoIP calls when in range of a compatible WiFi router and mobile calls over a cellular network when out-of-range. Two UK companies are now offering 'converged' fixed and mobile services in this manner: BT (which launched BT Fusion in June 2005, initially over Bluetooth, but now uses WiFi technology) and Orange (which launched Orange Unique in September 2006).

Quite a number of companies have deployed indoor Wi Fi hotspots within their office premises in Pakistan.

5. WiMAX

The original WiMAX system was designed to operate at 10-66 GHz and it had to change to offer broadband wireless access (BWA) in the 2-11 GHz frequency range. To do this, the WiMAX standard includes variants (profiles) that use different combinations of radio channel types (single carrier –vs-multicarrier), modulation types, channel coding types to provide fixed, nomadic or portable services.

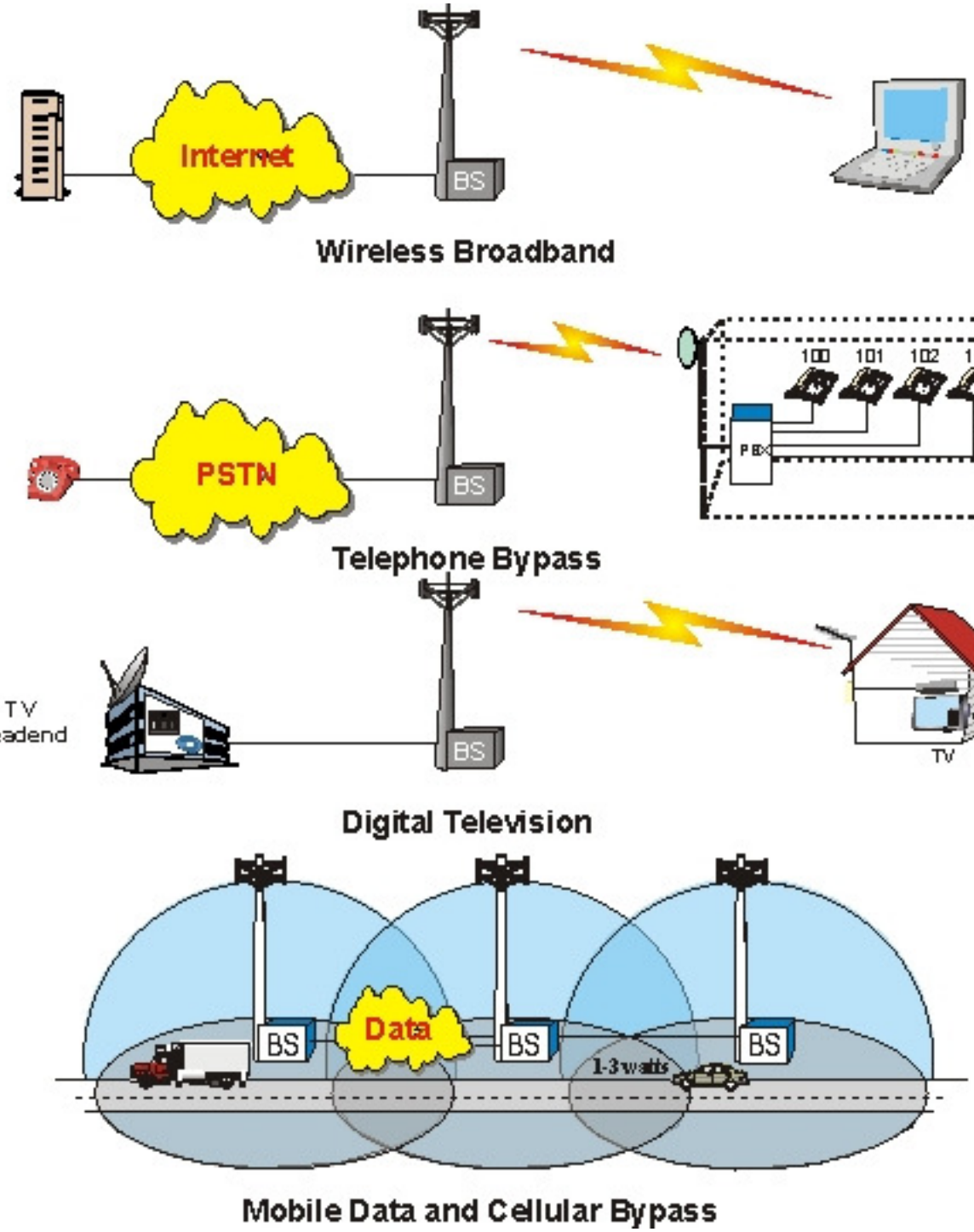
WiMAX can provide multiple types of services to the same user with different QoS levels. For example, it is possible to install a single WiMAX transceiver in an office building and provide real time telephone services and best effort Internet browsing services on the same WiMAX connection. To do this, WiMAX was designed to mix contention based (competitive access) and contention free (polled access) to provide services which have different quality of service (QoS) levels.

Operators can use the mesh configuration to allow it to link base stations without the need to install or lease interconnecting communication lines. Some of the services WiMAX operators can provide include leased line, residential broadband, commercial broadband and digital television (IPTV) services.

WiMAX can use radio channel bandwidths that can vary from 1.25 MHz to 28 MHz and data transmission rates can exceed 155 Mbps. The types of data connections on WiMAX radio channels include basic (physical connection), primary (device control), secondary (configuration) and transport (user data).

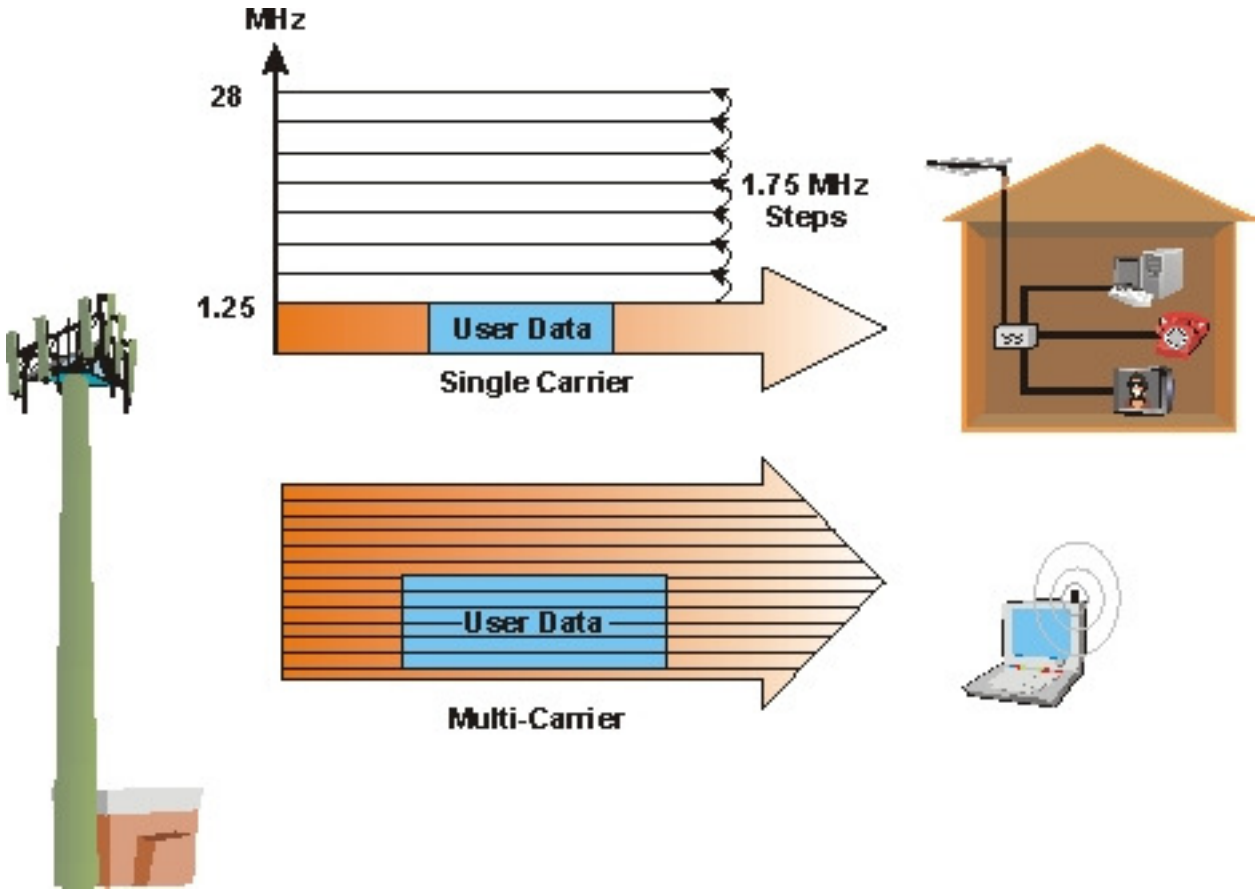
WiMAX Applications

This figure shows some of the applications that WiMAX systems can be used for. This diagram shows that WiMAX can provide wireless broadband Internet access, telephone access services, television service access and mobile telephone services.



WiMAX Radio Channel Types

Following figure shows that WiMAX radio channels can be single carrier or multiple carriers. This diagram shows that the bandwidth of WiMAX radio channels can vary from 1.25 MHz to 28 MHz in steps of 1.75 MHz. This example also shows that a WiMAX system that is using multicarrier OFDMA and how some of the subcarriers have been assigned to a specific user.



WiMAX Standard Differences

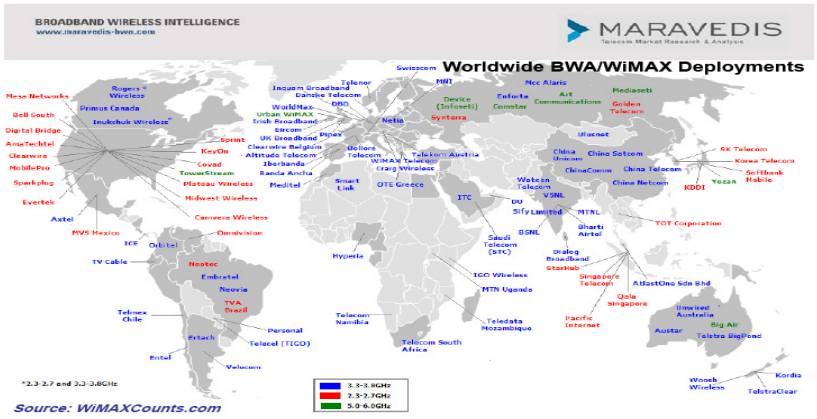
Figure below shows a comparison between the original Fixed WiMAX standard and the WiMAX standard that can be used for fixed, mobile and portable. The table shows that the original 802.16 standard was released in 2004 and it was only capable of providing fixed wireless data services. It used OFDM modulation and could be deployed in both TDD or FDD formats. The 802.16e standard was released in 2005 (now merged into the original 802.16 standard) was designed for fixed, mobile and portable operation. It used OFDMA modulation with TDD and optionally FDD duplexing capability.

Characteristic	Fixed WiMax	Mobile WiMax
Industry Standard	802.16-2004	802.16e-2005
Access Type	Fixed	Fixed, Portable and Mobile
Modulation	OFDM	OFDMA
Duplexing	TDD, FDD	TDD, FDD Optional
Handoffs	No	Yes
Types of Service Providers	DSL, Cable Modems and Competitive Access Providers (CAPs)	Mobile Operators, DSL, Cable Modems, Wireless and Wired ISPs
Subscriber Units	High Performance Outdoor and Indoor CPE	Low Cost Consumer Electronics CPE and Embedded Modules
Preferred Frequency Bands	2.5 GHz, 3.4-3.6 GHz 5.8 GHz	2.3-2.4 GHz, 2.5-2.7 GHz, 3.3-3.4 GHz, 3.4-3.8 GHz

WiMAX Deployment

Pipex Wireless began the UK's first commercial WiMAX trial in Milton Keynes in December 2006 and plans to launch in Manchester in late 2007 and then roll-out services to 50 UK towns and cities by 2009.

However, because its licence (for the use of 3.6-4.2GHz spectrum) does not support mobility, in the absence of any future investments in mobile spectrum,



Pipex will use WiMAX for fixed applications. It has stated plans to focus on providing backhaul for municipal WiFi deployments, while also offering a wireless local loop equivalent to consumers and businesses which require faster uplink services than those typically provided by basic DSL services.

M/S Wateen has successfully deployed WiMAX in Pakistan on commercial scale and already cultivated a sizeable customer base.

6. Optical Fibre Access Network

The market for taking fiber to the customer premises is complex, from both a technology and business perspective. Rapidly increasing bandwidth requirements and business justification are both critical drivers for the need to put more fiber in telcom access networks. Although a mix of other technologies also will be used to provision broadband access, fiber to the user will play an increasingly important role. In today's broadband market, competition, demand, bandwidth and investor pressure keep growing, while regulatory constraints and deployment costs are declining.

Several factors impact the business and network transformation that service providers are experiencing. The top market drivers are the ability to compete for customers and manage the top line and substituting new revenues for more traditional voice service revenues, while also trying to cut operating expenditures.

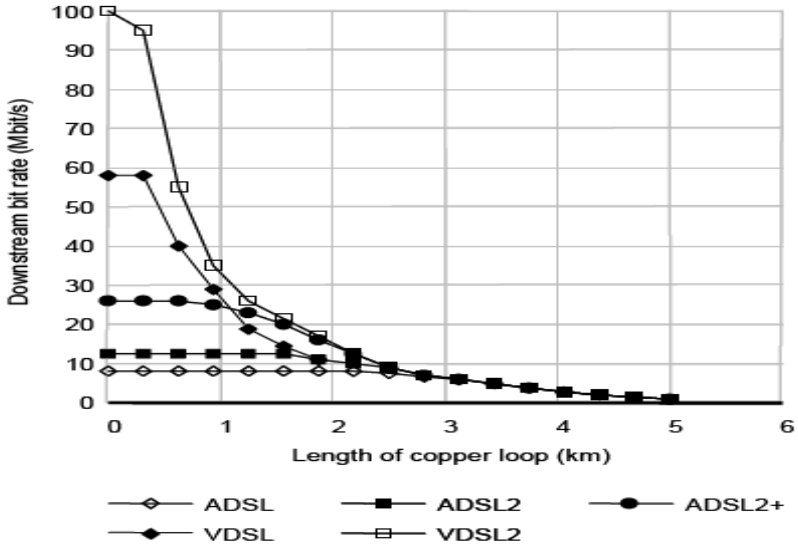
Earnings per user of the service providers offering traditional voice services can potentially be doubled by adding high-speed Internet access to the existing services. The ability to then add video services to the equation can make that revenue figure jump up to much higher earnings.

Most earlier generation broadband networks were built to support only one service, using a legacy ATM-based network. With increasing demand for triple-play-capable networks that can support delivery of voice, video and data applications, telecom network operators are moving from a strictly ATM environment to an environment where much more Ethernet and IP are factored in. These changes are transforming the fixed network from a reliance on ADSL to reliance on advanced access, including fiber-to-the-home (FTTH).

ADSL technology promises to deliver about 8 Mb/s on a short copper loop. The longer the loop, the more that throughput decreases. ADSL2+ offers up to 25 Mb/s on short loops, while VDSL provides higher rates on short loops. Fiber to the premises, in a gigabit passive optical network (GPON) architecture, potentially can provide more than 50 Mb/s. The networks of tomorrow are likely to see a broad mix of all of those technologies in use. Following drawing depicts decrease in speed encountered with increase in distance.

Variations in theoretical DSL downstream

data rates versus length of copper loop



Source: Analysys Research, 2006

For example, Bell Canada is using older copper-based technologies now, with plans of moving increasingly to fiber-to-the-node (FTTN) and ultimately fiber-to-the-premises (FTTP) architectures over the next 10 years. In new build situations, SBC Communications is able to provide FTTP buildouts at about the same cost as copper. However, SBC has told investors that FTTN provides bandwidth-rich speeds at only one-fifth of those for FTTP. Following chart depicts achieveable speed.

7. Fibre to the Home (FTTH)

Cost of rolling out alternative local network based on Fiber to the Home (FTTH), has reduced over the years. FTTx, however, remains an expensive option compared to the 'last mile' copper pair and broadband wireless access. FTTH offers connection speed of up to 100Mbps, 50 times faster than a typical ADSL connection. This high speed allows for much richer applications such as streaming video and video telephony. Depending on how it is implemented, FTTH can also offer symmetric communication speeds.

Nayatel in Pakistan has already laid FTTH in Islamabad and launched its commercial services.

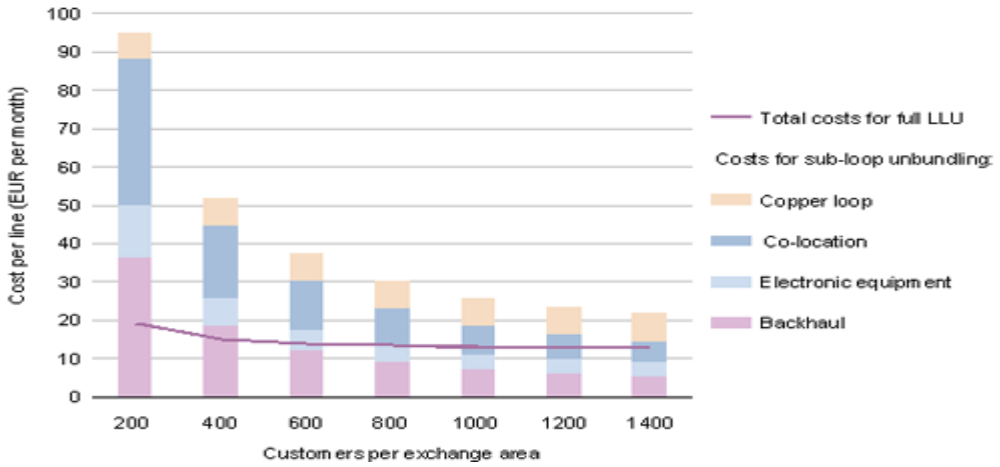
8. Fiber to the Curb/Node (FTTC/FTTN)

Fibre to the curb/node (Street Cabinet), and the consequently shorter copper loops, might allow operators to provide bandwidth-hungry offerings such as TV over DSL more effectively, and compete with some of the very high-speed offers emerging from cable and fibre operators, without incurring the high levels of investment necessary to deploy fibre to the building.

The costs of sub-loop unbundling are substantial. There is the cost of new equipment at each cabinet, likely to include a multi-service access node (MSAN) to deliver voice and data services, and the establishment of co-location facilities. Again, there is the cost of acquiring a backhaul link to each individual street cabinet with the potential risk of the writing off the cost the of equipment and co-location facilities at the local exchange.

However, the biggest difficulty faced by a prospective sub-loop unbundler is the limited economies of scale that it may be able to achieve. Whereas an alternative operator with a modest share of the DSL market might expect to gain 500 or more customers at a major exchange, it may only be possible to gain 10–20 customers at a single street cabinet. This is a tiny number of lines over which to recover the costs of a dedicated MSAN, co-location facility and backhaul link

Following graph illustrates how (based on some very simple assumptions) the monthly cost per customer for full LLU and sub-loop unbundling varies depending on the number of customers achieved within a typical urban exchange area. Costs are annualised over five years and are based on vendor prices and typical EU rates for copper loops, co-location and backhaul to the core network (all assumed to be regulated at cost).

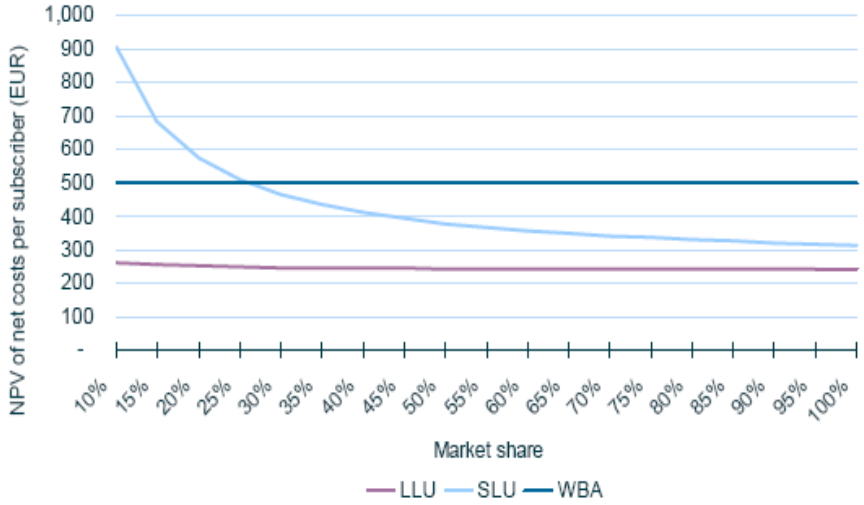


(Source: Analysys Consulting, 2007)

For full LLU, the economies of scale are largely exhausted once an unbundler achieves 500 or so lines at the exchange, which is viable for the largest players in most markets. The economies of scale are much more significant for sub-loop unbundling, and they continue to be significant even as the number of customers rises well above 1000 per exchange. This suggests that even given tight regulation of essential facilities at cost-based rates, the unbundler is always likely to be at a relative disadvantage to a larger incumbent.

It is also notable that even for a sub-loop unbundler with more than 1000 customers at an existing telephone exchange the switch to sub-loop unbundling only makes economic sense if ARPU can be doubled through introduction of new services over the SLU. Business users may be willing to pay such a price, but will the mass market really pay this much for faster connections, and the chance to buy a high-quality TV over DSL service? It seems unlikely.

Regulators are already beginning to grapple with some of the issues this raises, such as balancing potential improvements in service to end customers against the risk of stifling infrastructure-based competition, but the outcome is far from clear. In the meantime, local loop unbundler will need to consider their strategy very carefully. Such a network suits the incumbent on economies of scale. Following graph depicts possible impact

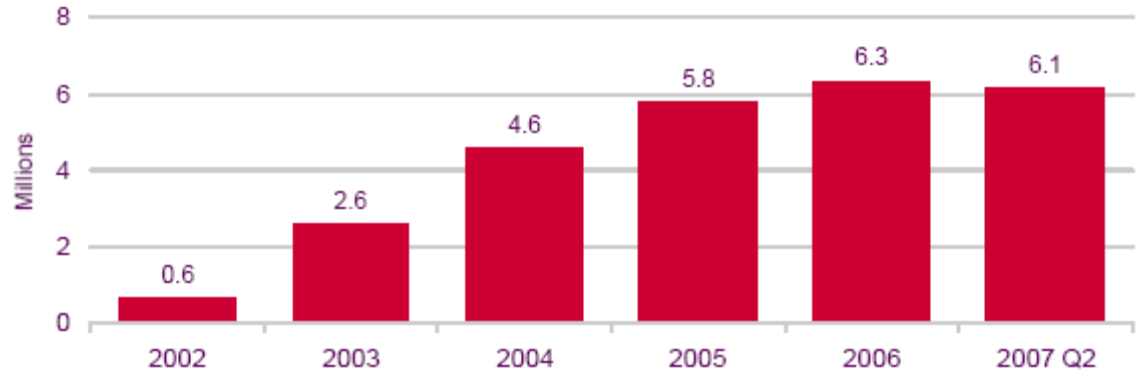


Fibre to the cabinet could also have significant adverse consequences for local loop unbundling, particularly if the incumbent, after migrating to optical fibre network were to sell off its aging primary cables (between exchange and street cabinet), meaning that local loop unbundling (LLU) at the exchange was no longer available. In this scenario, the operators selling their services through such local loops might have to choose between withdrawing to a wholesale DSL product and investing in sub-loop unbundling at the street cabinet or simply fade away in the face of heavy investment required.

PTCL in Pakistan has laid Optical Fibre Access Network in twelve big cities where last mile is the copper. This arrangement presents possibility of much higher speeds to its customers.

9. Carrier pre-selection (CPS)

Carrier pre-selection allows customers of the incumbent operator to route all of their calls via another operator while continuing to pay line rental to the incumbent. Growth in the number of CPS-enabled lines, in UK, slowed during 2006 before starting to fall in Q4, a trend that has continued into 2007. At the end of 2006 there were 6.3 million CPS lines, 9% more than at the end of 2005, but this had fallen to 6.1 million by the end of June 2007 (Figure below) operators such as TalkTalk migrating their CPS customers onto full LLU-based services.



Source: Ofcom / operators

Carrier selection is already deployed, successfully, in Pakistan.

10. Wholesale Line Rental (WLR)

Wholesale Line Rental (WLR) is a service in which a telecommunication operator takes control of all the connections made through a telephone line from the native operator and collects the subscription fee from the subscribers.

A good example of this is TalkTalk where by they rent mutiple phone lines off of BT for a reduced rate, and pass this saving on to their customers

At the end of 2006 the number of lines using wholesale line rental (WLR) services stood at 4.2 million in UK, an increase of 1.9 million on a year previously. By combining data on the use of full LLU and CPS services with data on the number of cable operator and alternative network operator lines we can see that at the end of 2006 36% of UK fixed lines were taking a fixed access or call service from an operator other than BT, an increase of two percentage points since 2005 as shown above. This calculation excludes WLR lines to avoid double-counting, as these will use a CPS service to route calls.

III. Unbundling around the Globe

A. History of unbundling

United States of America

The Federal Communications Commission (FCC) was the first regulator to obligate telecom operators in the US to unbundle their networks under the Telecommunication Act 1996. The objective of the 1996 act was to promote competition in order to secure lower prices and higher quality services for consumers and encourage the deployment of new telecommunications technologies.

Under this ACT incumbent local exchange carriers (ILEC) were mandated to provide competing telecommunications carriers with access to the parts of the telecommunications network of the incumbents on an unbundled basis. Together, these parts make up a local loop that connects to a digital subscriber line access multiplexer (DSLAM), a voice switch or both. The loop allows non-facilities-based telecommunications providers to deliver service without laying network infrastructure, such as copper wire, optical fiber, and coaxial cable.

The Act provided three ways for companies to enter the new competitive telecommunications market:

1. Facilities systems,

2. Unbundled access

3. Resale networks

Unbundled access allowed companies, such as cable television, wireless providers, and electric/gas utilities, who already had customers, installation and maintenance crews, and billing systems, to lease the network elements they were missing, such as a voice switches, or electronic ordering systems, to complete their local telephone system.

The 1996 Act, thus mandates that the traditional vertical hierarchy of the telephone industry be divided into parts, known as **Unbundled Network Elements(UNE)**, so that competitive new entrants can choose what they need to provide competitive local telecommunications service.

Network Elements that Must be Unbundled under the US law

1. **Loops**. Incumbent local exchange carriers (ILECs) must offer unbundled access to loops, including high-capacity lines, xDSL-capable loops, dark fiber, and inside wire owned by the incumbent LEC.

2. **Subloops**. Incumbent LECs must offer unbundled access to subloops, or portions of the loop, at any accessible point. Such points include, for example, a pole or pedestal, the network interface device, the minimum point of entry to the customer premises, and the feeder distribution interface located in, for example, a utility room, a remote terminal, or a controlled environment vault. If parties are unable to reach an agreement pursuant to voluntary negotiations about the technical feasibility of unbundling the loop at a specific point, the incumbent LEC will have the burden to demonstrate to the state that it is not technically feasible to unbundle the subloop at these points.

3. **Network Interface Device (NID).** Incumbent LECs must offer unbundled access to NIDs throughout their service territory. The NID is a device used to connect loop facilities to inside wiring.

4. **Circuit Switching.** Incumbent LECs must offer unbundled access to local circuit switching, except for switching used to serve end users with four or more lines in access density zone 1 (the densest areas) in the top 50 Metropolitan Statistical Areas (MSAs), provided that the incumbent LEC provides non-discriminatory, cost-based access to the enhanced extended link. (An enhanced extended link (EEL) consists of a combination of an unbundled loop, multiplexing/concentrating equipment, and dedicated transport. The EEL allows new entrants to serve customers without having to collocate in every central office in the incumbent's territory.)

5. **Interoffice Transmission Facilities.** Incumbent LECs must unbundle dedicated interoffice transmission facilities, or transport, including dark fiber. Incumbent LECs must also unbundle shared transport (or interoffice transmission facilities that are shared by more than one carrier, including the incumbent) where unbundled local circuit switching is provided.

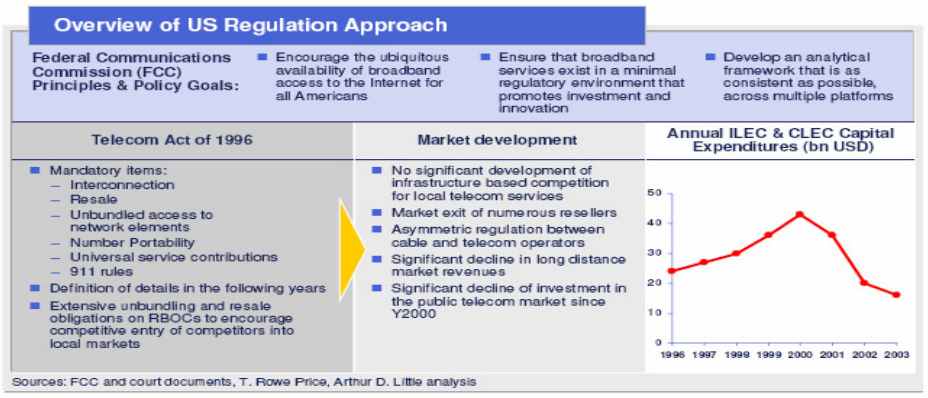
6. **Signaling and Call-Related Databases.** Incumbent LECs must unbundle signaling links and signaling transfer points (STPs) in conjunction with unbundled switching, and on a stand-alone basis. Incumbent LECs must also offer unbundled access to call-related databases, including, but not limited to, the Line Information database (LIDB), Toll Free Calling database, Number Portability database, Calling Name (CNAM) database, Operator Services/Directory Assistance databases, Advanced Intelligent Network (AIN) databases, and the AIN platform and architecture. The Commission found that incumbent LECs need not unbundle certain AIN software.

7. **Operations Support Systems (OSS).** Incumbent LECs must unbundle OSS throughout their service territory. OSS consists of pre-ordering, ordering, provisioning, maintenance and repair, and billing functions supported by an incumbent LEC's databases and information. The OSS element includes access to all loop qualification information contained in any of the incumbent LEC's databases or other records needed for the provision of advanced services.

The FCC developed a forward looking long run incremental cost (LRIC) based on assumptions of a modern efficient network for the pricing of the unbundled network elements. Right from the start, the FCC's decision on unbundling was challenged by ILECs. The list of UNEs and the pricing methodology were the key issues being challenged.

Although FCC achieved some successes in increasing the market share of new entrants, UNE obligations led to a decline in infrastructure investments. The incumbents cut back on investments into their network because their investments were not protected from the new entrants. The new entrants, on the other hand, choose to rent facilities instead of incurring high capital investments.

Unbundling led to decline in infrastructure investment in US



In 1999, FCC narrowed its list of UNEs by eliminating operator assistance and network assistance. However, in a separate Order, FCC added dark fiber, sub-loops, and the high frequency portion of the copper loop used to provide DSL (or Line Sharing) into the list of UNEs. This decision was again challenged by the ILECs in court.

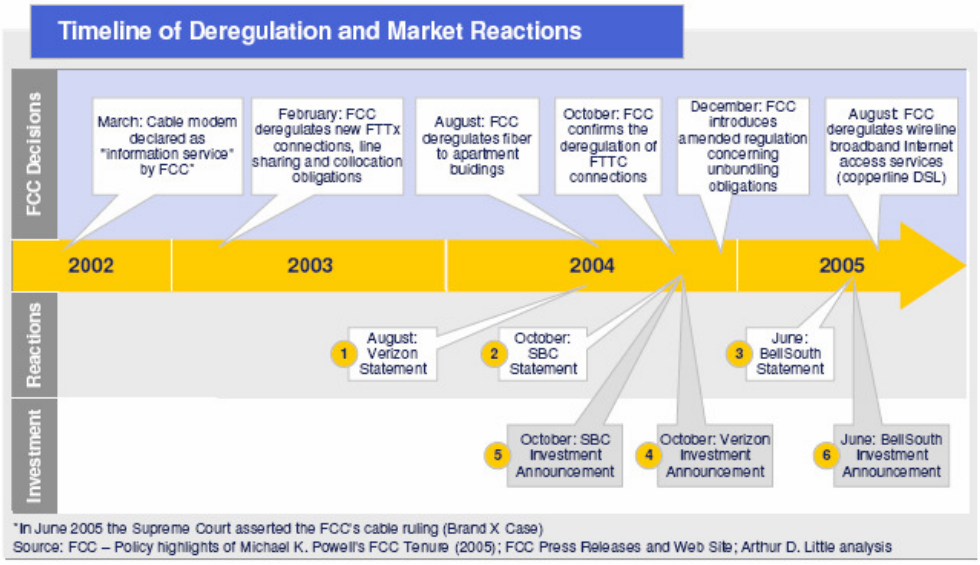
In 2002, the D.C. Court issued its decision on the case and remanded FCC for interpretation of barrier of entry for new entrants and its list of UNEs. It also found that FCC failed to adequately take the following factors into considerations:

- Cost of unbundling
- Disincentives to invest in infrastructure caused by unbundling
- Natural monopoly characteristics of the industry and the cost disadvantages faced by all new entrants
- Competition from cable modem

In August 2003, the FCC released the Triennial Review Order which removed most of the unbundling obligations imposed on the ILECs. Line sharing was to be phased out over three years and fiber deployment was fully exempted from unbundling.

Following the Triennial Review, the FCC made a series of announcements in 2004 and 2005 to remove unbundling obligations from the operators. After these announcements, most of the unbundling obligations were eliminated, except UNE-Loop (Local Copper Loop Unbundling).

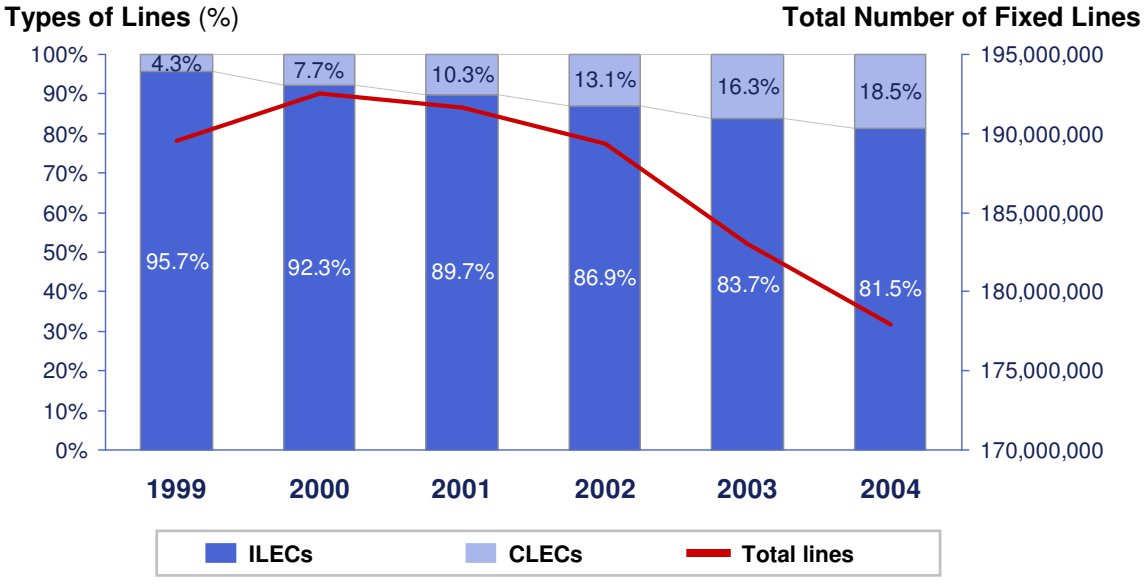
Trendline of Unbundling and Market Reaction



Unbundling did help new entrants to wrest market share from the dominant operators. During the period between the mandating of unbundling to Dec 2004 the new entrants in the US had gained 18.5% (32.9 million lines) market share in access lines while the total number of fixed lines had started to decrease.

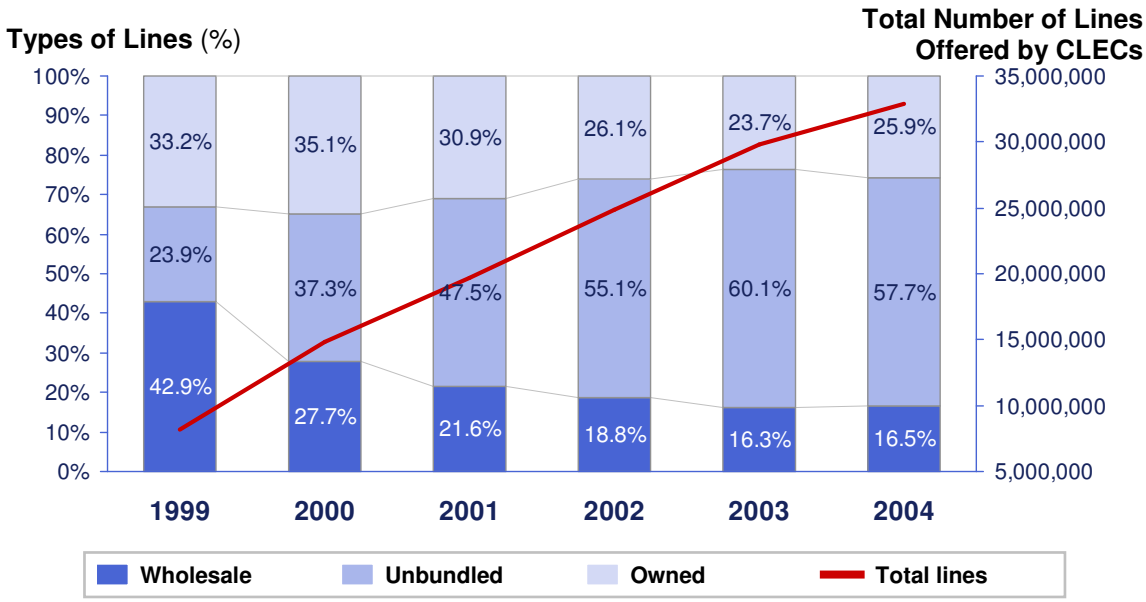
Out of the share of the new entrants about 16% (5.4 million) were wholesale lines, while 58% (19 million) were unbundled lines (UNE-P, UNE-L and Line Sharing), and about 26% (8.5 million) lines were owned by the new entrants. Out of the 8.5 million lines owned by the new entrants, about 44% were coaxial cables and the rest were mostly copper with a small percentage of fiber and wireless local loop.

CLEC Market Share of Access Lines in US



Source: FCC Local Competition Report 2005

CLEC access lines by types



Source: FCC Local Competition Report 2005

Unbundling framework in the US when most of the original unbundling obligations were lifted in 2004 & 2005 as a result of legal challenges is summarized as depicted in the chart below.

Obligations to Regional Bell Operating Companies in US

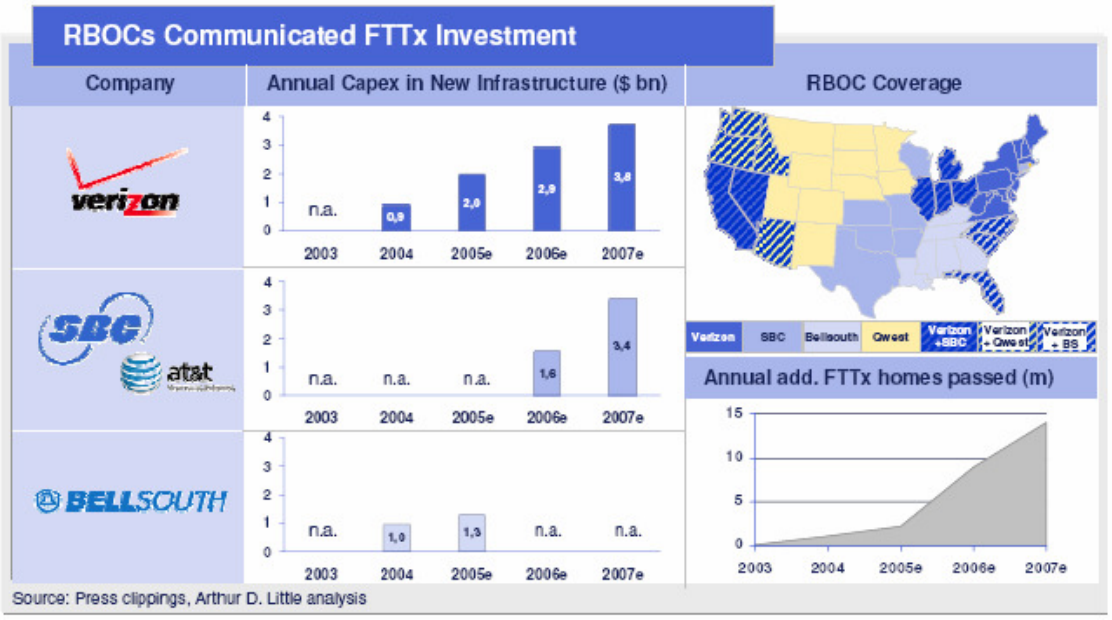
Obligation	Explanation	Telecom Act 1996	New Rule	Comments
UNE-P	Unbundled network elements-platform. Allows end to end service without owning infrastructure	In force, "cost-based" pricing	Eliminated ✓	Effective dates of UNE-P elimination are not uniformly defined
UNE-L	Unbundled network elements-loop. Local copper loop (does not include switching)	In force, "cost-based" pricing	Remains	CLECs will not be able to service customers unless they combine UNE-L and installation of their own infrastructure
Line Sharing	Access to the higher frequency portions of the local copper loop to provide DSL services	In force, "cost-based" pricing	Eliminated ✓	Line sharing is no longer available as an unbundled element. A 3 year transition period is established, with new orders only being accepted during the first year
Wholesale DSL Services	Allowed ISPs to buy DSL services at wholesale prices and resell them to end customers	In force, "cost-based" pricing	Eliminated ✓	No future obligation to provide access to wholesale wireline broadband Internet services. One year transition period. ISPs may still negotiate commercial wholesale agreements with an RBOC
Fibre and Hybrid Loop Unbundling	Refers to both FTTH and FTTC with a final copper connection	No rule	Not required ✓	No unbundling requirement in greenfield situations. Where fibre replaces copper or is installed alongside, limited unbundling requirements (either provide access to narrowband fibre or to a spare copper loop)

Note: Please refer to glossary in appendix Sources: FCC and court documents, Arthur D. Little analysis

Source: FCC and court documents, ADL analysis

The FCC announcements were welcomed by the ILECs and they were followed by new network investment announcements from both the ILECs and the CLECs. Following diagram depicts the plans announced by the historic incumbent operators Verizon, AT&T and Bell South for fresh invest in FTTx projects.

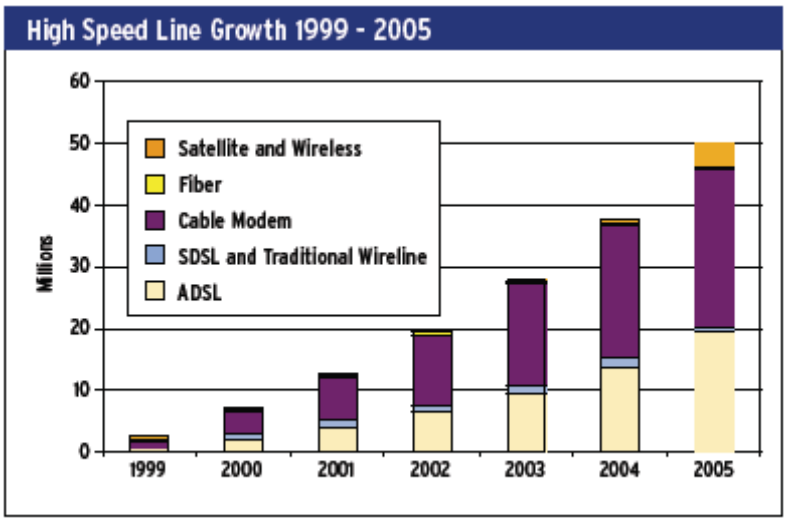
Fresh investments plans announced by dominant operators



Encouraged by the investment environment created where the operator was not required to provide access to its competitors and utilize its network to offer competitive services without having to make substantial investments, other market players also announced their own plans to lay their own infrastructure to remain competitive and ensure their future role in the market place. Following picture depicts the announcement made by market players.

Fresh investment plans announced by competing companies

Under the new unbundling framework investments in optical fibre network picked up. The trend is captured by the graph below where broadband over the optical fibre has taken a substantial role as compared to previous years.



Source: FCC'S High Speed Services for Internet Access Report, July 2006

Canada

Canadian Radio-Television and Telecommunications Commission (CRTC) imposed mandatory unbundling obligations on the dominant operators in May 1997. A set of three network elements was recognized central to ensuring level playing field for the new entrants for growth of healthy competition. The competition however did not materialize; scope of unbundling was therefore further raised to eleven for the operators to offer a mix of services to their customers without investing in the infrastructure. Unbundling of these eleven elements was considered necessary for the new entrants to enter the market and enhance their presence to a sustainable level in the face of the competition in a period of five years when the facilitation will cease and they will have to raise their own infrastructure.

Using this set of criteria, the network elements mandated to be unbundled were:

- Central office codes (Unique code for an exchange within the numbering plan)
- Subscriber listings (name, address and telephone number) which appear in the telephone directory
- Local loops in rural and small urban areas

Besides the essential facilities, CRTC also issued mandatory unbundling for near essential facilities with a sunset clause of 5 years from May 1997. However in 2001 CRTC extended the sunset clause for the near essential facilities without a target termination date since the anticipated competition could not take place. CRTC decided to monitor the market and set the termination date once it felt that the competitive landscape warrants the termination.

Under the criteria the network elements mandated to be unbundled were:

- Local Loops in urban areas
- Inside Wire
- Local Switching
- Transiting of Traffic

- Signaling Networks
- Directory Assistance Databases
- Directory Assistance
- Directories
- 9-1-1 Service
- Message Relay Service

Access to Rights-of-Way and Support Structures

It was argued that unbundling telephone company networks into discrete components would enable competitors to mix their own facilities with those of the telephone company in the most efficient manner. Criterion fixed that obligated the dominating operator was:

a) It is monopoly controlled,

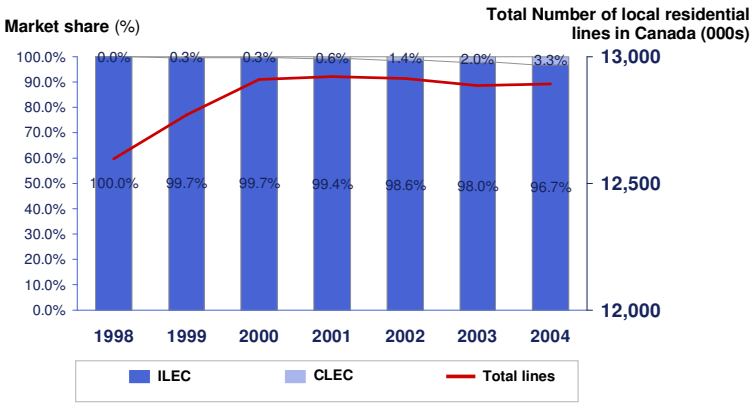
b) Competitive local exchange carrier requires it as an input to provide services; and

c) Competitive carrier cannot replicate it, economically or technically.

CRTC considered submissions arguing for TSLRIC and TELRIC pricing models, but it concluded that rates for unbundled facilities should be based on Total Utility Segment Phase II costs - a measure of future-looking incremental costs associated with the provision of services exclusive of joint or common costs - plus a 25% mark up.

From 1998 to 2004, the CLEC have not been able to gain much market share in the local access lines, accounting for only 3.3% of residential lines and 12.4% of business lines as of 2004. As for internet access market, cable operators have given the ILEC more competition than the CLEC in the residential market. For business internet access market, ILEC actually gained market share since unbundling was imposed in 1997.

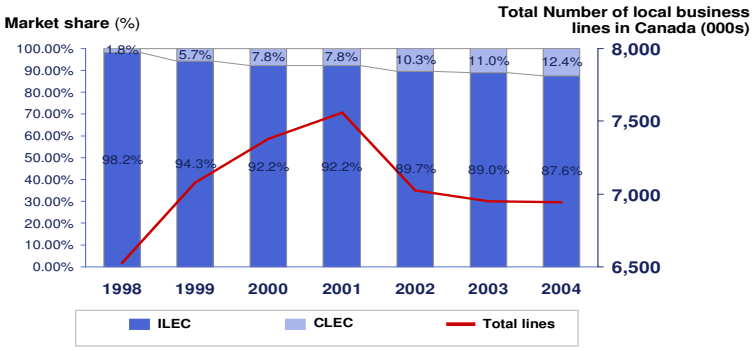
Market share of local residential lines



Source: Report to the Governor in Council: Status of Competition in Canadian Telecommunications 2005, CRTC

For the business lines, the CLECs fared slightly better, accounting for 12.4% of market share as of 2004. This shows that the CLECs are focused on the lucrative business market.

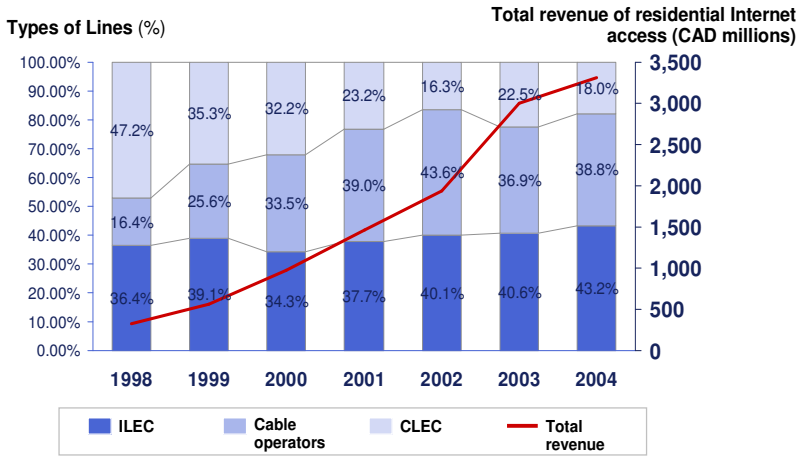
Market share of local business lines



Source: Report to the Governor in Council: Status of Competition in Canadian Telecommunications 2005, CRTC

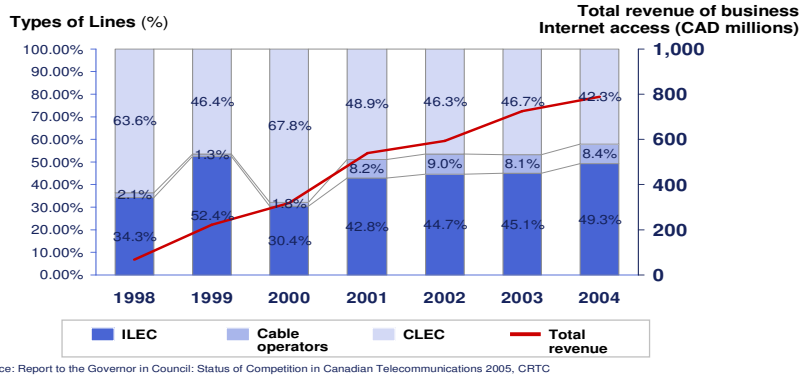
In the residential Internet access market, cable operators proved bigger challenge to the ILECs compared to the CLECs. As for the business market, the ILEC gained market share after 7 years of unbundling.

Market share of residential internet access



Source: Report to the Governor in Council: Status of Competition in Canadian Telecommunications 2005, CRTC

Market share of business internet access



Source: Report to the Governor in Council: Status of Competition in Canadian Telecommunications 2005, CRTC

Overall, the results of unbundling in Canada have not met CRTC initial objectives of promoting competition.

United Kingdom

Oftel issued a statement in Nov, 1999, *Access to Bandwidth: Delivering Competition for the Information Age,* which set out its decision to require BT to make its local loop available to other operators. Oftel concluded after a year long consultation that the opening up of the local loop was necessary to introduce competition for the provision of broadband services. The statement also concluded that local loops should be available at cost based prices.

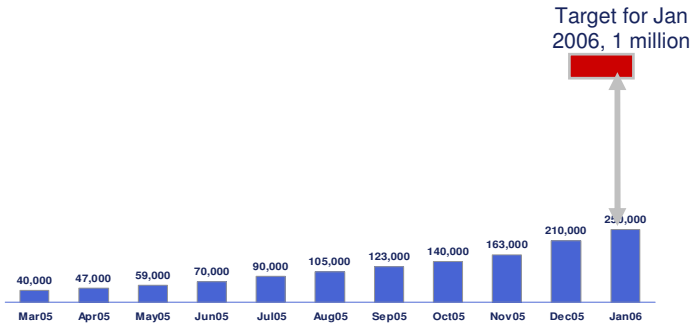
A new condition (Condition 83) was inserted into BT' license in April 2000, to be effective on 8th Aug; 2000 setting out conditions for supply of unbundled local loop and co-location facilities for BT products and the conditions for the supply of these products and unbundled loops, criteria to set the prices and dispute resolution procedures.

The European Council issued regulation on LLU (EC/2887/2000) that came into force in January 2001. The regulation requires incumbent operators throughout Europe to offer unbundled access to their local loops on reasonable request. Although local loop was made available by BT to new operators, the progress was far below the expectations.

Ofcom appointed the Office of the Telecoms Adjudicator (OTA), an independent office staffed by industry veterans to oversee the rollout of LLU, in July 2004 to ensure effective competition in broadband sector to accelerate broadband growth.

The rate of unbundling has increased in 2005 and as of January 2006, 250,000 lines have been fully unbundled. However, this is still far below the target of one million unbundled lines by January 2006 set by OTA and Ofcom. As of Jan 2007, fully unbundled lines account for less than 1% as of total broadband lines in UK despite the initiatives taken by Ofcom.

Total number of lines unbundled in UK

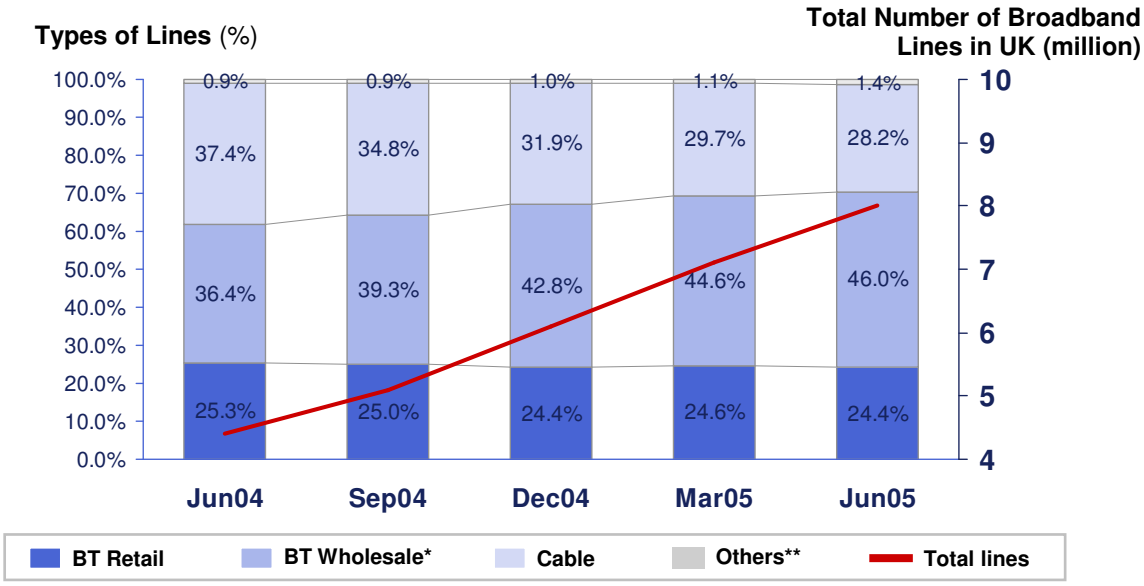


Source: Office of the Telecoms Adjudicator (OTA)

Bitstream Access

The implementation of bitstream access is lot more successful than fully unbundled lines in UK. Since 2004, BT Wholesale, which sells bitstream access to other operators, overtook BT Retail in terms of market share of broadband lines. In Jun 2005, bitstream access accounted for 46% of all broadband lines in UK, the most dominant type of lines by far.

Broadband lines in UK



*BT Wholesale: Bitstream Access

**Note: Others include Local Loop Unbundling, Satellite, Fixed Wireless Access and lines provided by Kingston Communications (regional incumbent in the East Yorkshire area)

Soucre: Ofcom Quarterly Updates Aug 2005

In September 2005, BT and Ofcom reached a settlement which includes more than 230 separate undertakings that are legally binding on BT. Key objectives of these undertakings are as follows:

1. To allow all communications providers to gain real equality of access to critical BT infrastructure on fair and equal terms

2. Lower prices and greater choice of products and services for consumers and businesses through more competition

3. Encouraging investment in infrastructure, and enabling innovations and deployment of next-generation technology

From these undertaking, BT started a new business unit Openreach, which is responsible for maintenance of BT's national telecoms network and the installation of new infrastructure. Openreach had about 30,000 employees when it began operation in January 2006; most of them are existing BT engineers. The products and services offered by Openreach include:

- Local Loop Unbundling (LLU)
- Wholesale Line Rental (WLR)
- Backhaul Extension Services (BES)
- Wholesale Extension Services (WES)
- Number Portability
- New Products

Although it is still part of BT, it has been fenced off from the rest of the organization with its own headquarters and staff. Openreach has to treat BT like it treats all other telecoms operators, with the same pricing and service level. The operations of Openreach are overseen by the Equality of Access Board (EAB) which is a special committee set up within BT's board to comply with Ofcom requirements.

Since Openreach derives its revenue from providing services to other telecoms operator, it will have incentives to serve as many customers as possible. It was hoped that these arrangements will create level playing field for all operators especially in the area of access. It has already started to pay dividends.

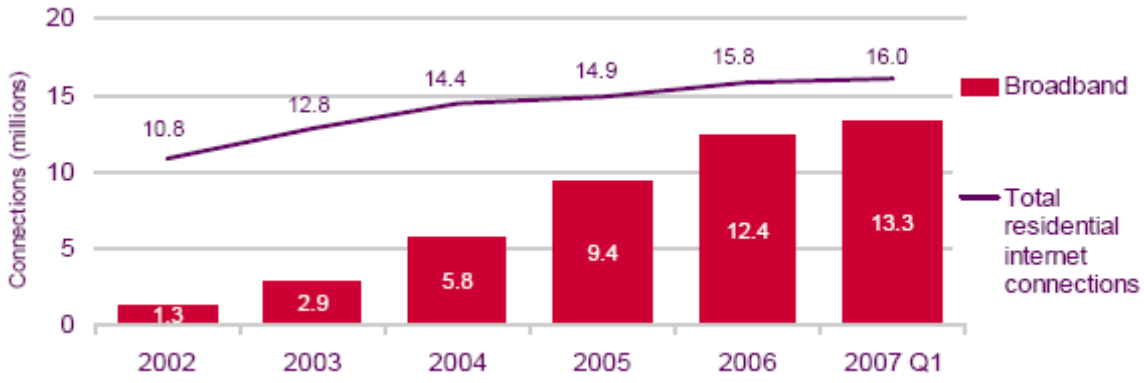
During 2006 the number of LLU broadband lines increased from 0.2 million to 1.3 million and LLU accounted for 10% of all UK broadband connections, compared to 2% a year ago.

The increasing availability of LLU services in 2006 and aggressive pricing by providers increased LLU share of broadband connections. This was at the expense of cable and non–LLU DSL connections, where growth slowed and market share reduced. Cable's market share fell by three percentage points to 24% in 2006, while total non-LLU DSL connections fell by five percentage points to 66%. A split of the total broadband lines with a split of various types of unbundling is placed hereunder:

LLU, wholesale line rental and carrier pre-selection lines

Growth of residential internet in UK is depicted below:

UK residential internet connections

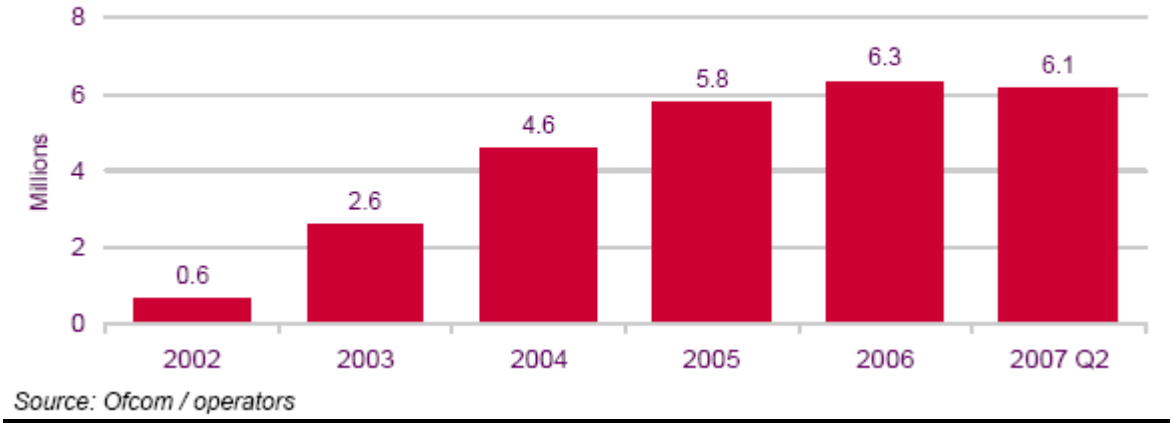


Source: Ofcom

Carrier pre-selection starts to decline as operators switch to full LLU

Carrier pre-selection (CPS) allows customers of the incumbent to route all of their calls via another operator while continuing to pay line rental to the incumbent. Growth in the number of CPS-enabled lines slowed during 2006 before starting to fall in Q4, a trend that has continued into 2007. At the end of 2006 there were 6.3 million CPS lines, 9% more than at the end of 2005, but this had fallen to 6.1 million by the end of June 2007 (Figure below). This decline is attributed to the migration of broadband from shared local loop to full LLU thus ridding the need of CPS.

Figure 4.24 Carrier pre-selection (CPS) enabled lines



Source: Ofcom / operators

There are now **3.931 million** unbundled LLU lines as of Jan 2008 and the indications are that demand remains strong as communication providers continue to implement their network strategies. There are 4.56 million WLR lines and the number of telephone numbers using CPS remains at 5.89 million.

Sub Loop unbundling is not in vogue yet. Pricing for the Plan and Build element of the current Sub Loop product has been released by Ofcom while the Connection and Line pricing remains to be worked out.

The work on re-engineering the existing Sub Loop processes has been completed to the extent of enabling a meaningful trial, monitor feedback and gain input from the trial deployment being run in London and the South Yorkshire Digital Region project when it commences. The lessons learned so far are being fed back to the Co-ordination group.

Australia

Summary

Telstra is one of the most dominant incumbent telecoms operators among developed countries. It is the only incumbent that dominates all three networks of fixed line, mobile and cable TV. Local loop unbundling (LLU) and wholesale bitstream access was introduced in Australia in August 2000. Since then, the broadband market in Australia experienced accelerated growth with a compound annual growth rate (CAGR) of 105% from 2001 to 2005. Much of the growth was driven by wholesale bitstream access. Telstra has been accused of anti-competitive behavior in trying to squeeze out the broadband resellers. In 2005, the Parliament of Australia passed a bill to breakup Telstra into three separate units; networks wholesale and retail.

Brief History of Unbundling

Unlike most other countries, the rollout of Local Loop Unbundling was overseen by the competition agency, Australian Competition and Consumer Commission (ACCC), instead of the telecoms regulator Australia Communications and Media Authority (ACMA). In July 1999, ACCC decided to regulate LLU

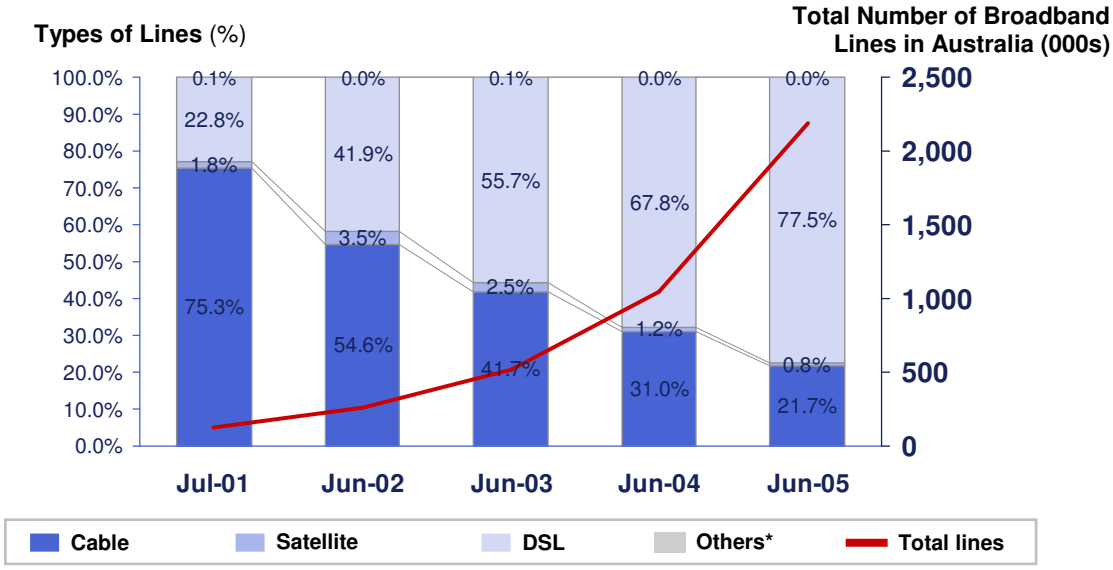
to enable competitors to use Telstra's copper lines to deploy DSL technologies in order to deliver both voice and high speed data services. ACCC ensured that Telstra would not commercially launch its own ADSL offerings before providing an equivalent opportunity for others to also offer similar services through the use of Telstra's copper network.

Telstra responded by giving written assurance to ACCC that it would launch LLU and wholesale ADSL (Bitstream Access) in August 2000[4].

Developments of Australia Broadband Market

Since 2001, the broadband market in Australia has experienced exponential growth. Total number of broadband lines increased from 122 thousand lines in July 2001 to about 2.18 million lines in June 2005 (CAGR of 105%). Growth in DSL was especially significant, with CAGR of 179%, far outstripping the growth of cable broadband lines with a CAGR of only 50%. DSL lines overtook cable in 2003 as the most popular type of broadband access lines and by June 2005 accounts for more than 75% of the total broadband market.

Types of broadband lines in Australia



*Others include mainly wireless broadband access

Source: Paul Budde – Australian Broadband Statistical Overview Oct 2005

Progress on Unbundling

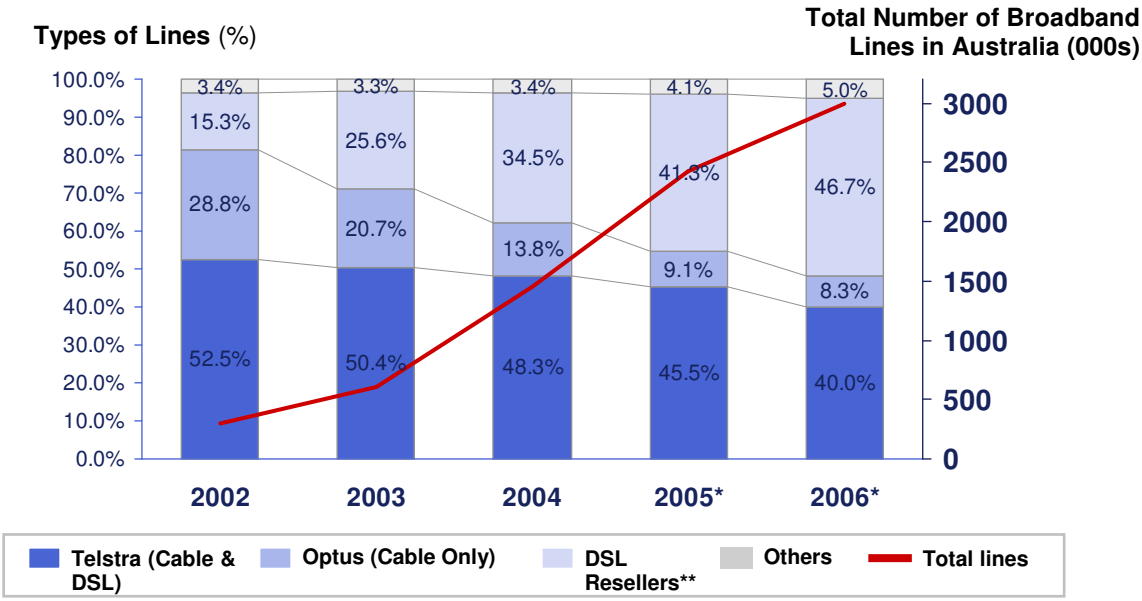
Although Telstra's unbundling efforts began in 2000, as of December 2005, the number of physically unbundled lines is estimated to be around 103,000[5]. This accounts for only about 4% of the total broadband market.

On the other hand, the DSL resale market has really taken off and the combined market share of all DSL resellers should overtake the market share of Telstra.

[4] Source: Australian Competition and Consumer Commission

[5] Source: JP Morgan Australian Broadband Market Report (Feb 200^)

Market share of different players



*Figures for 2005 and 2006 are forecasted numbers
** Optus is also a DSL reseller
Source: Paul Budde – Australian Broadband Statistical Overview Oct 2005

Anti-competitive Behavior by Telstra

Price Squeeze

In the first quarter of 2004, Telstra lower the retail prices of its broadband services while keeping the wholesale prices unchanged. This adversely affected Telstra competitors who purchased broadband capacity from Telstra and resell it at retail level. Following an investigation by ACCC, Telstra agreed to give A$6.5 million in compensation to its competitors in February 2005 and reduced its wholesale prices.[6]

National Averaging of Wholesale Broadband Prices

Due to the vast land mass of Australia and the relatively small population, the cost of providing telecommunications access varies greatly between the city areas and the rural areas. Currently, Telstra have a de-average pricing structure for its wholesale services, which ranges from A$7 in capital city central business districts to A$13 per customer per month in metropolitan suburbs and A$144 in rural areas[7].

In 2005, Telstra proposed a new wholesale pricing scheme which will be A$30 per customer per month regardless of location. This means that the cost for Telstra competitors will increase by a large percentage in urban areas, which is where 95%[8] of telecoms competition takes place. The ACCC is unlikely to approve the new proposed pricing scheme, but as of February 2006, no final decision has been made.

[6] Source: Australian Competition and Consumer Commission

[7] Source: Sydney Morning Herald (Feb 2006)

[8] Source: Paul Budde Communications (2005)

New Telecommunications Act 2005

In September 2005, the Parliament of Australia passed a series of bills that have serious implications for Telstra. The key elements of these bills are:

- The separation of Telstra into three units: network, wholesale and retail. With a so-called 'Director of Equivalence' appointed by Telstra to oversee the process
- Each unit will have its own staff, buildings and remuneration incentive schemes which should allow each unit to maximize the success of its own business.
- Telstra's wholesale customers will get equivalent services to Telstra Retail, taking into account special conditions for Telstra, based on its larger volume and certain vertical business efficiencies

Telstra will be allowed to draft the initial version of the new structure and submit it for public consultation and approval by the Minister for Department of Communications, Information Technology and the Arts (DCITA). The timing of the separation is dependent on the approval process and the Australian government is targeting to finalize the plan in 2006.

European Union

Unbundling process in European Union has been long - the first action in the EU resulted from a report written for the European Commission in 1993. It took several years for the EU legislation to require unbundling and then in individual EU countries the process took further time to mature to become practical and economic rather than simply being a legal possibility.

The 1993 report referred to the logical requirement to unbundle optical fibre access but recommended deferral to a later date when fibre access had become more common. In 2006 there were the first signs that (as a result of the municipal fibre networks movement and example such as Sweden where unbundled local loop fibre is commercially available from both the incumbent and competitors) policy may yet evolve in this direction.

Singapore

Singapore's telecoms market was fully liberalized in 2000. In line with the liberalization, the Infocomm Development Authority (IDA) reviewed its interconnection policies in April 2000 and imposed unbundled network elements (UNE) obligations on the incumbent Singtel. The pricing methodology was based on the Long Run Incremental Cost (LRIC) method and unbundling offer from Singtel was approved in 2001 as part of the overall Reference Interconnection Offer (RIO).

The second fixed line operator, StarHub, acquired the local cable TV operator in 2001 and started offering its fixed line services through the cable TV network instead of using UNE from Singtel. As of December 2005, cable accounted for 46% of broadband market share, close behind the 53% market share of DSL. The largest operator that uses UNE from Singtel to provide services is Pacific Internet, which had about 1.3% of market share in December 2005.

Hong Kong

Mandatory local loop unbundling policy (termed Type II Interconnection started in 1995 (the year of telephone market liberalization), to ensure choice to customers. After 10 years, new operators have built their networks covering a large region of Hong Kong; the government considered it a good time to

withdraw mandatory local loop unbundling policy, to persuade operators to build their own networks and let businesses run themselves with a minimum of government intervention. At the meeting of the Executive Council on 6 July 2004, the Council advised, and the Chief Executive ordered, that the regulatory intervention under the current Type II interconnection policy applicable to telephone exchanges for individual buildings covered by such exchanges should be withdrawn, subject to conditions laid down conditions. After that, the terms of interconnection will be negotiated between telephone operators. Hong Kong is the first and the only advanced economy that has withdrawn the mandatory local loop unbundling policy.

Hong Kong due to its unique geography and adoption of unbundling at a very early stage is one extreme example where unbundling, after achieving the objective of fair competition, is not mandated anymore.

New Zealand

The Commerce Commission recommended against local loop unbundling in late 2003 as Telecom offered a market-led solution. In May 2004 this was confirmed by the Government, despite the intense "call4change" campaign by some of Telecom's competitors. Part of Telecom's commitment to the Commerce Commission to avoid unbundling was a promise to deliver 250,000 new residential broadband connections by the end of 2005, one-third of which were to be wholesaled through other providers. Telecom failed to achieve the number of wholesale connections required, despite an attempt by management to claim that the agreement had been for only one-third of the growth rather than one-third of the total. That claim was rejected by the Commerce Commission, and the publicised figure of 83,333 wholesale connections out of 250,000 was held to be the true target. The achieved number was less than 50,000 wholesale connections, despite total connections exceeding 300,000.

On the 3rd of May 2006 the New Zealand Government announced it would require the unbundling of the local loop. This was in response to concerns about the low levels of broadband uptake. Regulatory action such as information disclosure, accounting separation of Telecom New Zealand business operations, and enhanced Commerce Commission monitoring was also announced.

New Zealand is now the 29th out of 30 OECD countries to unbundle the local loop (although not completely unbundled 17/10/2007). The only country that has not yet unbundled its local loop is Mexico.

Switzerland

Switzerland is one of the last OECD nations to provide for unbundling, because the Swiss Federal Supreme Court held in 2001 that the 1996 Swiss Telecommunications Act did not require it. The government then enacted an ordinance providing for unbundling in 2003, and Parliament amended the act in 2006. While infrastructure-based access is now generally available, unbundled fast bitstream access is limited to a period of four years after the entry into force of the act.

Unbundling requests tend to be tied up before the courts, however, because unlike in the EU, Swiss law does not provide for an ex ante regulation of access conditions by the regulator. Instead, under the Swiss ex post regulation system, each new entrant must first try to reach an individual agreement with Swisscom, the state-owned ILEC.

South Africa

In May 2006 the Minister of Communications of South Africa established the Local Loop Unbundling Committee to recommend the appropriate local loop unbundling models. The Local Loop Unbundling Committee in May 2007 recommended in its report all three models of unbundling i.e. Full Unbundling,

Line Sharing and Bitstream Access. It was further recommended that customers should exercise carrier pre-selection and thus be able to switch between service providers. It was also recommended that an organization be created to manage the local loop and that this organization should be under the guidance of the regulator Icasa and that Icasa be capacitated in terms of resources. The committee recommended that service providers approved by Icasa should have access to the telephone exchange infrastructure whenever necessary. The committee recommended that a regulatory guideline be established and managed by Icasa to guarantee that strategic issues like quality of the local loop be optimized for regulation and delivery of services. Based on this report policy on unbundling was issued and the telecom regulator entrusted to move swiftly to initiate unbundling of the local loop.

B. LLU Deployment around the globe

LLU requires significant up-front investment in each local exchange for the operator to be in a position to serve the fist customer. For instance, space preparation, equipment and backhaul installation. These costs can vary significantly depending on the configuration, but based on statements made by LLU operators the cost for a typical large scale operator are quite high. Subsequent costs are predominantly driven by the number of lines unbundled, e.g. modem-port costs, line connection costs, annual loop rental charges and operational costs such as power consumption and billing. Therefore, in order to achieve a 'low' average cost per end user, at a given exchange, it is necessary to achieve a 'high' number of unbundled lines.

Clearly, there is a greater possibility of achieving a 'high' number of unbundled lines in a larger exchange, that is, an exchange that serves a large number of consumers. It is for this reason that LLU is predominantly being used in large exchanges, which are generally located in densely populated areas. The combination of high initial cost and the need to achieve 'high' volumes means that in general LLU will be attractive to larger players who have access to capital. However, irrespective of size, some operators prefer the option of purchasing wholesale products instead of using LLU. Also, if an operator uses LLU only in densely populated areas, it may continue purchasing wholesale products from the incumbent outside these areas to achieve national coverage. Broadband is facilitating the move to convergence around the globe.

Accessing content over broadband, once a minority activity is becoming an established part of media consumption. Majority of all broadband users accesses media content online, and some listen to audio or download video clips on a weekly basis. If 2005 was the year when audio downloads reached mass-market appeal, 2006 saw a step-change in the popularity of various types of online video content:

Video downloads over the open internet have long been available, but gained widespread momentum in 2006, exemplified by the popularity of the Google-owned video sharing site YouTube. Online presence has also become a must for traditional media outlets, with all major players offering access to some content online. But the lines between traditional and new media providers are blurring, as demonstrated by the BBC's deal with YouTube, announced in March 2007, to distribute clips from BBC programmes on the site.

Hundreds of streaming TV channels are now available online, both in the form of online-only channels (e.g. the 24-hour Music Plus TV), and those simulcasting broadcast channel content (e.g. Channel 4's web service). A growing number of online TV gateway portals such as ChooseandWatch.com and Beelinetv.com offer users one-point access to many streaming TV channels from around the world. In another development, Slingbox, a device which enables users to link their TV equipment to a home broadband connection and then watch their satellite, cable, digital or analogue TV over the internet from anywhere in the world, entered the broadband markets in 2006.

Countries around the globe have adopted varying approach towards local loop unbundling depending on their peculiar domestic market conditions and the objectives set for the proliferation of broadband. Most of the countries started off with all three types of unbundling however others started with line sharing alone and graduated to full unbundling.

Bit stream access has been the most controversial in the sense that some countries allowed it right from the start of unbundling and it did help these countries in generating competition in broadband market, for example Canada, while for others it was the single most important factor in broadband proliferation in that the new entrants were able to grab a sizeable market share for them to invest in their own infrastructure. While some countries, including the European Union, never mandated bitstream access. Here are few examples:

1. Line sharing was not offered by Deutche Telecom, the incumbent operator in Germany, while German government did not require line sharing until March 2001. In Canada, line sharing is not mandated by regulations but the incumbents have voluntarily implemented the service.

2. In Belgium, the problem with line sharing was complicated because the incumbents provided its ISP with line sharing but not new entrants. Such a "first mover advantage" has occurred in a number of countries giving the incumbents unfair advantage in the offer of broadband services over competitors. Following several orders from the regulator, the incumbent Belgacom included line sharing in its reference offer for LLU. However, operators have complained because the incumbent's reference offer for LLU requires that an end user subscribe to a single PSTN or ISDN from the incumbent before it will provide line sharing to an access seeker who wants to serve that customer.

3. The majority of OECD countries have still not introduced bitstream access. In many of the countries that have introduced bitstream access, the regulatory framework is viewed by ISPs as insufficient, for instance, bitstream access, offered by French Telecom, is not generally considered as a part of LLU, by operators rather as an important transitory measure while they roll out their unbundled access and collocation.

4. In Austria, bitstream access was made possible via an ADSL wholesale offer from the incumbent (so-called "ISPA contract"), in which prices and conditions were determined by an agreement between the Internet Service Providers Association of Austria (ISPA) and the incumbent. Similarly, the Swedish regulator does not regulate the price of bitstream access. The UK is one of the few OECD countries to have mandated bitstream access with a resounding success to start with.

5. Competitors in some countries focus on business users and do not pay much attention to residential users with respect to provision of services using LLU. This practice could correspond to normal market behavior in light of the fact that the customer expense per line is much higher in the business sub-market, in particular SMEs. This would mainly be because business DSL products can appear to be very attractive to SMEs, when compared to available alternatives such as leased lines or ISDN.

6. In Germany, for example, operators have concentrated on business customers and those private customers that generate high traffic volumes. This could be an outcome of the high monthly rental charges requested by the incumbent. French operators also seem to aim at the business sector. Even in Denmark, where the unbundling prices are fairly low, the main focus of operators is on business users.

7. Most European countries require unbundling only for local loops, whereas the US requires unbundling of other associated facilities initially, however now it has also graduated to LLU alone. In Japan, in addition to local loops, there is also a requirement to unbundle splitters for DSL, routing transmission function, optical splitter and media converters for FTTH.

There is a great deal of difference in the progress of LLU across OECD countries as measured by the ratio of unbundled loops to total subscriber lines. The United States and Canada lead with 5.5% and 4% of local loops unbundled.

Some of the assumed benefits and related risks to unbundling are listed below:

Bitstream Access- Conceived advantages:

- Full bitstream access enables new entrants to quickly build a sizeable customer base in the residential and SME segments that in turn could provide the necessary economies of scale to justify facilities based competition.

- Bitstream access is likely to promote investment in ADSL equipment and associated backhaul capability by the incumbent operator when mandated to offer non-discrimatory access to new entrants.

- Such an access strikes a reasonable balance between promoting broadband competition and maintaining investment incentives for alternative platform such as Broadband Wireless Access

- The arrangement promises to protect the investment of the incumbent in Next Generation Network (NGN) by not unbundling elements that have high investment risk

- Extends assurance to new entrants exit at a minimum cost if the services they offered were not supported by the market

- Mass market PSTN replacement by an NGN should primarily be driven by relative economic cost considerations. Retail minus bitstream pricing principle, if adopted, is above cost and hence would further augment investment incentives for both new entrants and the incumbent.

- The key inhibitor to higher penetration rate for broadband is the relatively high price for residential and small and medium enterprise (SME) market. It is therefore likely that market competition or the threat of real competition, in the provision of retail broadband would be the key driver of investment for the incumbent.

- Cherry picking is unlikely to be a problem under retail minus pricing.

Local loop unbundling- Conceived pitfalls

- New entrants face large DSLAM setup investment in each exchange area they wish to serve as against investment by the incumbent itself in bitstream access.

- Likely to be uneconomic in areas with small demand (residential entry unlikely)

- Likely to attract less entry and competition than “full” bitstream unbundling

- Likely to take a long time to introduce

- Complicates management and maintenance of local loop plant (increases operational costs)
- Large fixed cost of implementation may not be recovered if demand for unbundled loops is low
- Imposes significant regulatory costs

However it does not impact on alternative infrastructure investment incentives negatively.

C. Broadband Growth Trends

1. World Growth Trend

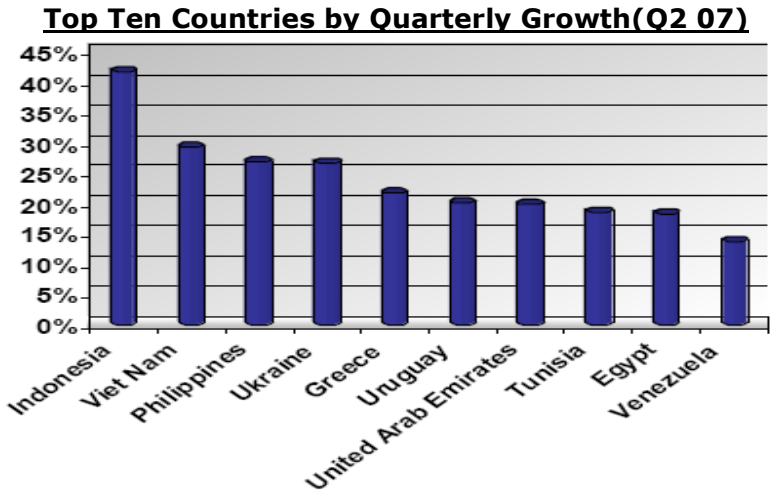
Worldwide total broadband subscribers stood at 313.6 million at second quarter of 2007. This new total represents a 4.90 per cent increase on the previous quarter's figure of 298.9 million and constitutes an additional 14.6 million subscribers worldwide. The total increase in the number of subscribers this quarter is somewhat less than increases which have been witnessed in preceding quarters. This quarter, an increase rate similar to that of the same period last year (Q2 2006) has been observed. Addition to number of subscribers has tended to be higher from the third to the first quarter of the year, with increases in additional subscribers dropping somewhat significantly in the second quarter.

The year-on-year growth rate between June 2006 and June 2007 was recorded at 27.23 per cent and represents more than 67 million additional subscribers worldwide. These additional subscribers brought world broadband total from 246.4 in Q2 2006 to 313.5 million in Q2 2007.

In Q2 2007, broadband population penetration was approximately 5.50 per cent, a 1.20 per cent increase on Q2 2006 and a 0.30 per cent increase on the previous quarter. The population penetration rate has now been increasing at a steady rate of approximately .30 per cent per quarter since Q4 2005, prior to which the rate of increase tended to fluctuate between approximately .20 and .30 per cent.

Top ten countries of the world with the highest broadband growth rate over the 2nd quarter of 2007 are depicted in the chart below. The chart only includes countries with 100,000 or more broadband lines by the end of the quarter. Indonesia experienced an exceptional quarter with a considerable increase in its subscriber base of 41.84 per cent. This brought the country's total subscribers from 122,321 to 173,500 in the quarter. This quarterly growth is 13.89 per cent higher than the rate experienced in the previous quarter and can be attributed to increase in broadband subscriber base of PT Telkom from 115,821 to 167,000 within the quarter.

Each of the top five on this quarter's table also showed strong growth in the preceding quarter however Uruguay (20.18%), United Arab Emirates (19.85%), Tunisia (18.60%), Egypt (18.41%) and Venezuela (13.83%) managed to make it to the top ten countries of the world in terms percentage growth in broadband subscribers

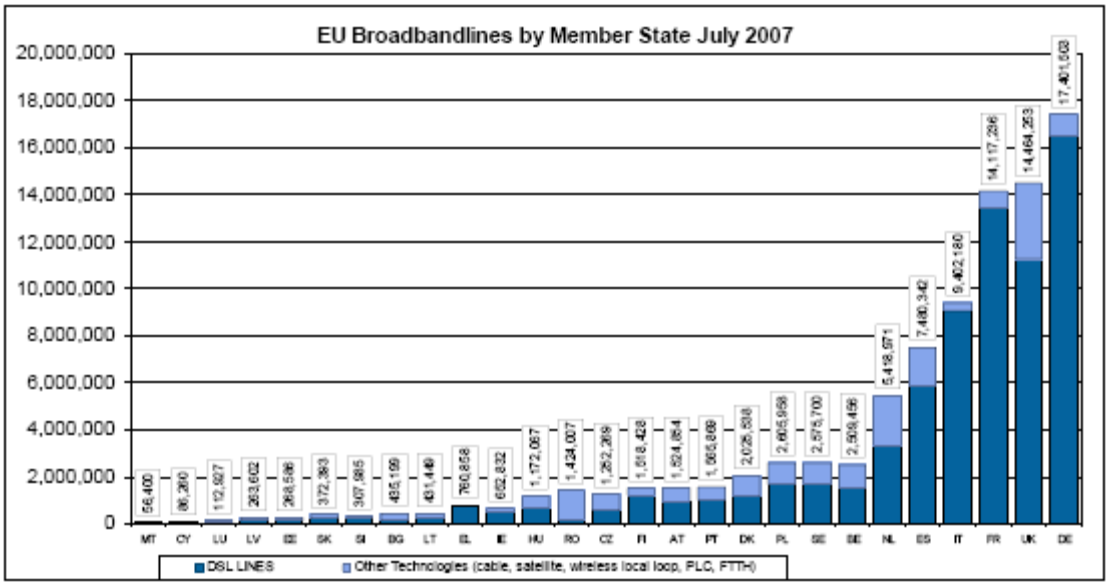


Source: Point Topic UK

It is interesting to note that most of the countries fall in "Developing countries" category**.**

2. Growth Trends in European Union

European Union total broadband subscribers stood at 90.2 million at second quarter of 2007. In the period between July 2006 and July 2007 a total of 21.5 million new broadband lines were added, an increase of 31.4%. Although in relative terms this growth is lower than in the previous twelve month period (42.0%), in absolute numbers it remains higher than the growth recorded between July 2005 and July 2006 (20.3 million lines). For comparison, new broadband lines added in the period between July 2006 and July 2007 excluding Bulgaria and Romania amounted to 19.6 million lines, which reveals a deceleration of growth in EU25. Following chart depicts the number of broadband lines in operation in various countries of the European Union.

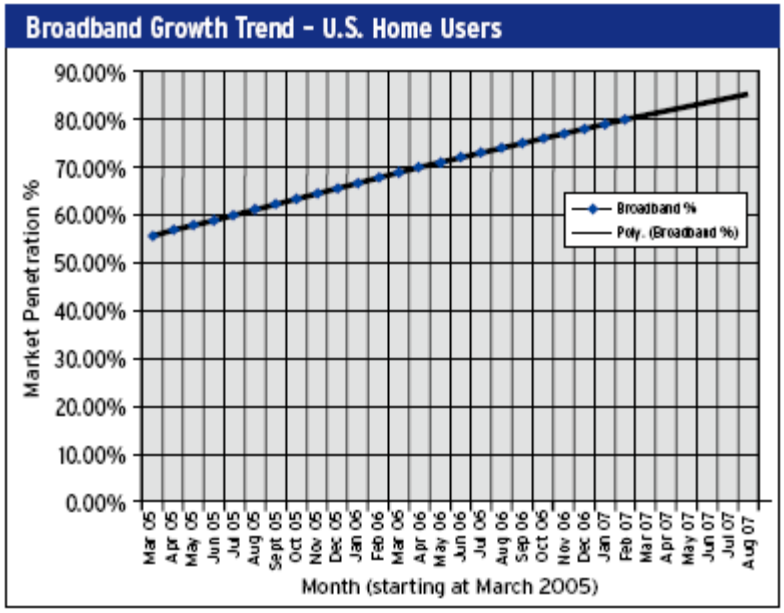


3. North American Growth Trend

North America holds 22.83% of the total worldwide broadband customers. In Q1 2007, North America gained 3.5 million additional subscribers. This figure fell to 2.17 million in Q2 2007, causing North America's quarterly growth rate to fall 2.20 per cent to 3.14 per cent in Q2 2007. The annual growth rate for North America for the period Q2 2006 to Q2 2007 was 21.90 per cent.

While total number of broadband in the US stood at 63.4 million customers at the end of 2nd quarter of 2007 with a growth rate of 22.95% on yearly basis while quarterly growth witnessed was 3.27 %

In January 2007, broadband penetration in U.S. homes grew 0.62 percentage points to 79.03%, up from 78.45% in December. This increase of 0.62 points is below the average increase in broadband of 0.9 points per month over the last 6 months.



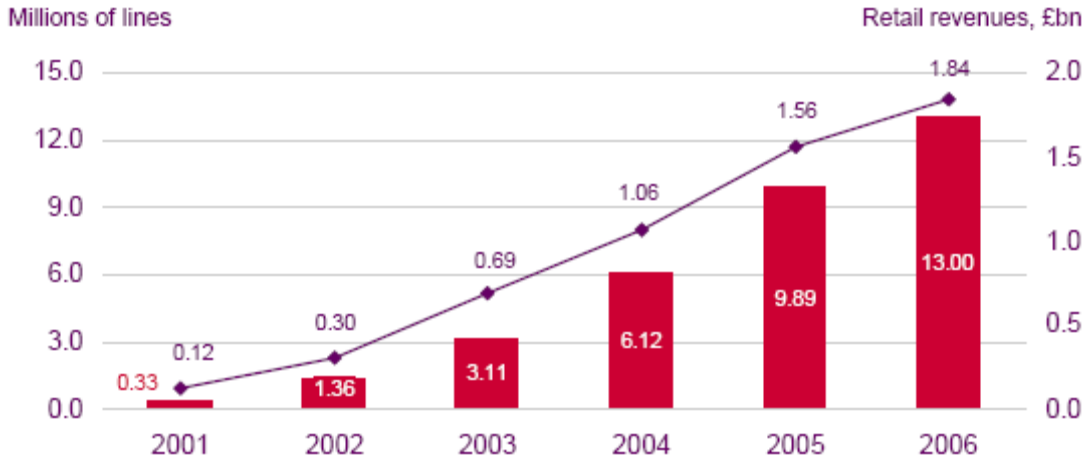
Extrapolated by Web Site Optimization, LLC from Nielsen/NetRatings data

The broadband penetration rate in urban and suburban households is almost double the rate in rural areas.

4. Growth Trends-UK

Total number of broadband lines in the UK stood at 14.5 millions at the end of 2nd quarter of 2007 with a growth rate of 24.84% on yearly basis while quarterly growth witnessed was 3.61 %

At the end of 2006, there were 13 million residential and SME broadband connections compared with just over 0.3 million in 2001 (Figure below). Growth has brought with it a corresponding rise in revenue. It is estimated that in 2006 residential and SME connections generated £1.84bn in retail revenue for broadband providers – a fifteen-fold increase in six years.



Broadband availability in the UK is among the highest in the world. In January 2006 BT reported that 99.9% of premises in the UK were connected to broadband-enabled exchanges (although not all of these premises are able to receive broadband due to local technicalities). In addition, 45% have access to digital cable infrastructure.

Growing competition among service providers over the past couple of years has resulted in significant declines in broadband prices during the past year. At the end of 2006, headline connection speeds of up to 2Mbit/s were available for £15 a month on a stand-alone basis, down from £50 in 2003. In addition, several operators offered free broadband as part of service bundles. At the same time, speeds continued to increase. In December 2006, the average UK broadband headline connection speed was 3.8Mbit/s, up from 1.6Mbit/s a year earlier. Some residential customers could achieve connection speeds as high as 24Mbit/s.

One factor stimulating sector growth over the past year was the introduction of a new LLU regulatory regime following Ofcom Strategic Review of Telecommunications in 2005; by February 2007 there were over 1.7 million unbundled lines in the UK, compared to only 365,000 at the end of 2005. Over 1,300 of BT's 5,600 exchanges were LLU-enabled, extending the availability of LLU-based services to two-thirds of UK population.

Do you agree that:

Local Loop Unbundling is the major catalyst in Broadband growth, if not, please give your arguments

D. Broadband Technology Trends

1. World Trends

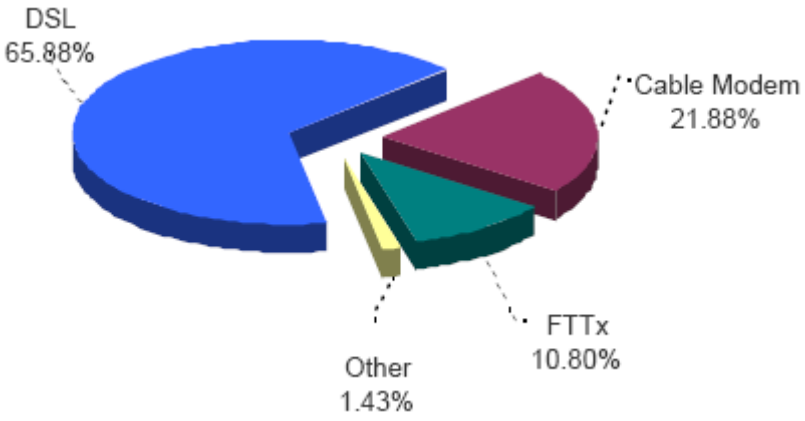
Chart below depicts broadband subscribers distributed amongst the underlying access technology around the globe. "Others" in the chart below include different forms of broadband Internet such as fixed wireless access, satellite and power-line while "fibre" in this context means anything from Fibre-to-the-kerb to Fibre-to-the-home which is often generalized as "FTTx."

It is evident from the chart that DSL is the technology of choice world over followed by Cable Modem; FTTx is gaining grounds and has started to outpace rest of the technologies quite recently.

On regional basis, Latin America, recently, has shown the fastest growth in broadband with growth of 10.10 per cent with Argentina leading the region with a quarterly increase of 11.5%. On year to year basis the growth in Argentina was recorded at 63.81%. The split of the growth in terms of DSL lines was 77.36% with a net increase in customer base to 1.269 million while non DSL customer base increased by 38.63% to 0.534 million customers. Annual growth for Latin America is also quite high with 45.16 per cent recorded for the period Q2 2006 to Q2 2007.

The highest annual growth in percentage terms for the year 2006- 2007 was witnessed in Russia where DSL lines increased by 106.24% as compared to 36.48% increase in non DSL lines.

Total Broadband by Technology



DSL, cable modem and FTTx subscriber figures continued to rise through 2007. DSL is clearly the most dominant of the three technologies with a 65.88 per cent share in the broadband market. The total DSL subscriber base crossed 206.5 million by the end of 2nd quarter of 2007, up 5.13 per cent on the previous quarter. Second in line is cable modem with a 21.88 per cent share in the market. The cable modem subscriber base crossed 68.6 million during the same period. This represents a 3.30 per cent increase on the previous quarter's total of more than 66.4 million subscribers.

With only 10.80 per cent of the market and a subscriber base of 34 million, FTTx possesses the smallest, but most fast-growing access method of the three technologies. FTTx has started to out-perform DSL and cable modem in terms of growth rate with world FTTx subscriber base registered at roughly 33.9 with a year-on-year growth rate of 39.67 per cent, considerably more than the respective DSL and cable modem rates of 26.89 and 21.57 per cent. However in terms of overall broadband lines added over DSL far exceed the number of lines over FTTx in real terms.

The DSL rate fell 1.63 per cent to 5.13 in Q2 2007 and the cable modem rate fell by 1.25 per cent to 3.30. FTTx, on the other hand, experienced an increase in its quarterly growth rate, which rose by .74 per cent, to reach 6.93 per cent.

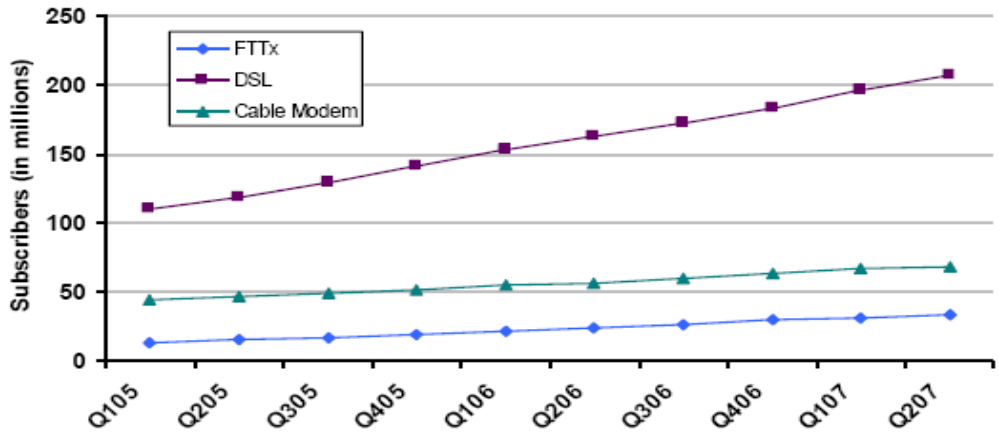
During the second quarter of 2007, FTTx out-performed DSL and cable modem in terms of quarterly growth with a rate of 6.93 per cent. By the end of Q2 2007, the world FTTx subscriber base had reached 33.8 million with a year-on-year growth rate of 39.67 per cent, considerably more than the respective DSL and cable modem rates of 26.89 and 21.57 per cent.

DSL and cable modem technologies experienced a decrease in their quarterly growth rates in Q2 2007. The DSL rate fell 1.63 per cent to 5.13 in Q2 2007 and the cable modem rate fell by 1.25 per cent to 3.30. FTTx, on the other hand, experienced an increase in its quarterly growth rate, which rose by .74 per cent, to reach 6.93 per cent. Clearly, FTTx is gaining ground in market share terms.

FTTx deployment is strongest in the three Asian countries. FTTx subscribers represent 23.78 million and 30.86 per cent of the total subscriber bases in China, Japan and South Korea respectively, higher than any other countries included in the top ten.

Split of various technologies adopted by the top ten countries with highest number of broadband connections gives a vivid picture of broadband deployment as depicted in the following graph:

Worldwide Broadband Technology Trends



Source: Point Topic UK

Clearly, FTTx is gaining ground in share terms; however, it has still a large ground to cover. Table below shows a general overview of the technology take-up by regions and clearly illustrates the dominance of DSL in Western Europe, of cable modem in North America and of FTTx in South East Asia and the Asia Pacific. In terms of DSL, Western Europe is the market leader with a 35.08 per cent share. Next in line is South East Asia with 26.35 per cent. All regions, aside from the Asia-Pacific region, experienced growth in DSL subscribers this quarter. The Asia-Pacific region

Table: 1 Broadband by Technology Q2 2007

Region	DSL	Cable Modem	FTTx
SE Asia	23.65	1.84	43.14
Asia Pacific	14.11	15.04	42.67
Latin America	5.42	5.78	

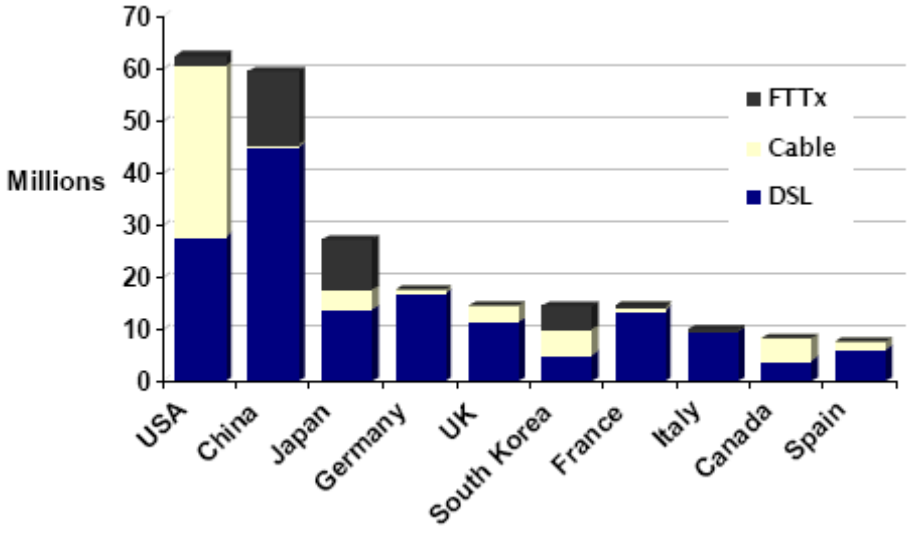
North America	15.26	54.25	5.15
ME & Africa	3.22	1.01	
Western Europe	35.08	18.02	2.88
Eastern Europe	3.26	4.06	6.16

Source: (World Broadband Statistics Q2 2007) Point Topic UK

A glance on the table above reveals that share of DSL technology is the highest in Western European countries while lowest for FTTx whereas the equation is entirely opposite when we look closer to home i.e. Asia Pacific and South East Asia. Almost whole of FTTx deployment i.e. 85.81% of the world deployment is within this region. However the growth rate is fastest as compared to other technology in the backdrop of diffusion of telecom and the entertainment.

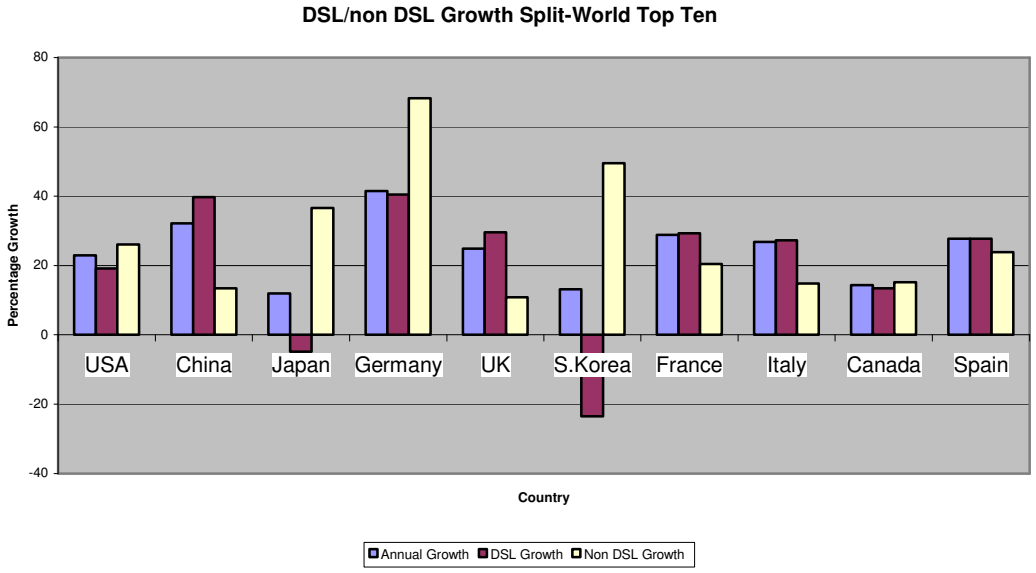
The reason, it appears, is that most of the developed countries had a high fixed line penetration and the telecom market liberalized when internet hit the telecom markets of the world and access to the customer already in place over the telephone lines for dial up connections. It was logical to benefit from the available infrastructure for high speed internet access hence development of ADSL.

Reason for Cable Modem to hold the second place as technology of choice for provision of high speed internet are again similar, the access to the customer, high investment prone part already in place, offered the incentive in developing the technology to deliver the service using available infrastructure. North America with the history of CATV carries the cake with 54.25% share of the broadband deployment over cable modem across the globe. Following graph depicts the picture more vividly:



The reason for sharing 85.81% of the world broadband deployment over FTTx between Asia Pacific and South East Asia seems non/low availability of existing infrastructure for delivery of broadband to the customer due to very low fixed line penetration and late/non liberalization of telecom market hence forcing the hand of the service provider to make heavy investments to cultivate corporate customers with an eye on the benefits of putting in place a better and reliable infrastructure to reap the benefits in the long run through early introduction of new services when these become available. Quality of the fixed line infrastructure laid by the incumbent coupled with aging and non existence of policy on unbundling are, it seems, other factors forcing hand of the investors to embark on an expensive solution for the provision of the service. However Japan seems an exception where the flair for on line gaming, it appears, has played key role in deployment of FTTx for to satisfy hunger for speed.

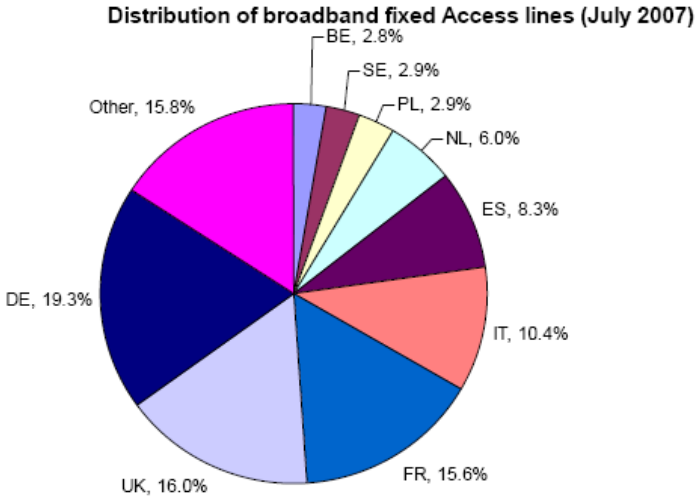
Graph below depicts the overall annual growth and the distribution of this growth between DSL and non DSL technologies in ten countries with highest number of broadband connections. DSL technology in Japan and South Korea suffered a negative growth, a pattern being seen in many other countries quite recently.



2. European Union Trends

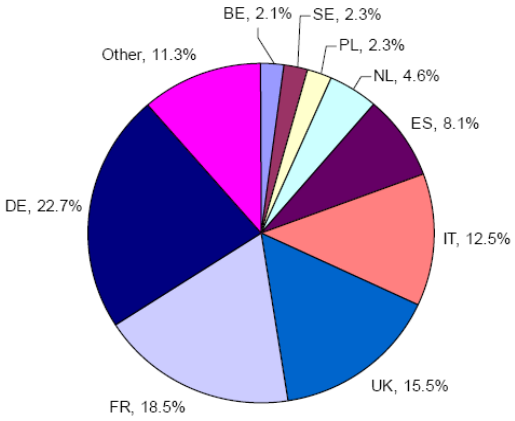
The implementation of Local Loop Unbundling is a requirement of European Union policy on competition in the telecommunications sector and has been introduced, at various stages of development, in all member states (Operators with Significant Market Power shall publish (from 31 December 2000, and keep updated) a post reference offer for unbundled access to their local loops and related facilities. The offer shall be sufficiently unbundled so that the beneficiary does not have to pay for network elements or facilities which are not necessary for the supply of its services, and shall contain a description of the components of the offer, associated terms and conditions, including charges). European States that have been approved for membership to the EU have an obligation to introduce LLU as part of the liberalization of their communications sector.

Out of a total of 90.2 million broadband lines in 27 countries of the European Union
72.4 million broadband connections employ DSL technology as of 1st July 2007 where Germany accounted for 19.3% of all broadband lines, followed by the UK and France, with 16.0% and 15.6% respectively. These three countries represent 50.9% of all EU broadband connections. Following drawing depicts share of each country in European Union.

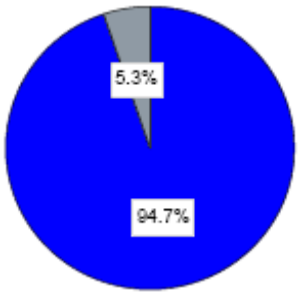


Distribution of total DSL lines is depicted in the following diagram. It is evident that the three countries with biggest share of the lines within European Union i.e. Germany, UK and France have also the biggest number of DSL lines. A further look into the individual markets of the above countries reveals that most of the broadband lines deploy DSL technology. Following drawings elaborate the situation.

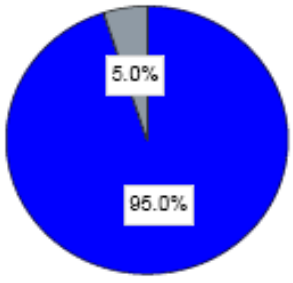
Distribution of DSL lines (July 2007) in European Union



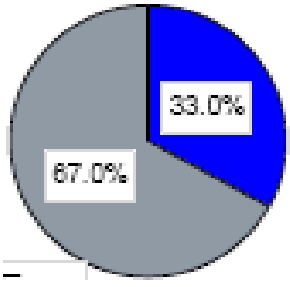
Germany (DE)



France (FR)

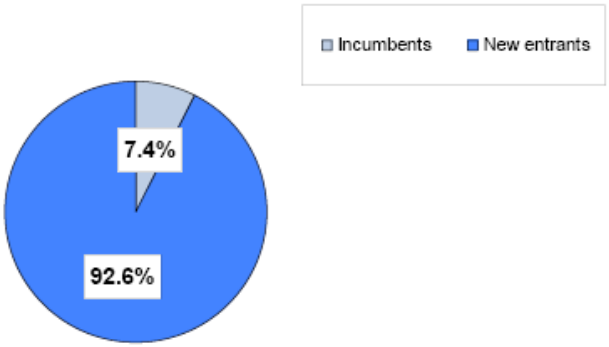


United Kingdom



Source:EU

80.3% of the total broadband lines are supported by DSL technology where only 19.7% accounts for all other technologies bunched together**.** Following drawing depicts the distribution of share amongst the incumbent and the new operators who have deployed access technology other than DSL for broadband provision to its customers:

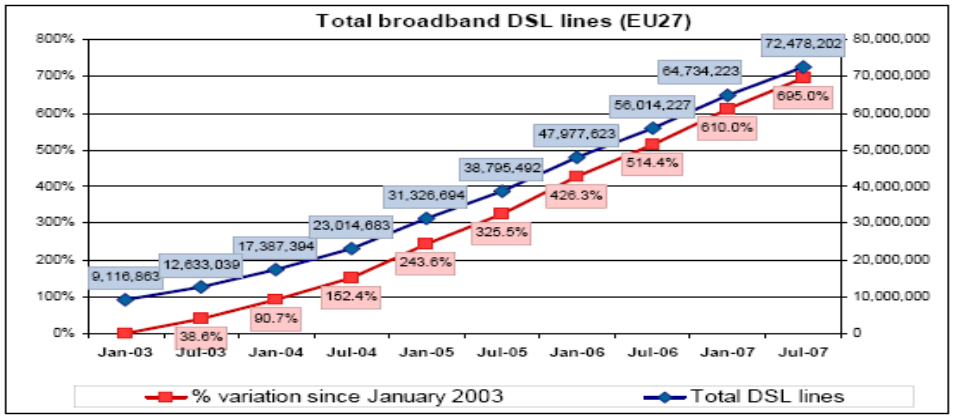


It is evident that the incumbents across EU have mostly depended on DSL while the new entrants impeded by the availability of unbundled local loop had to employ other means for fixed broadband connection.

DSL Growth Trend

The number of DSL lines added each day in the period between July 2006 and July 2007, in European Union was 44 293 (Bulgaria and Romania not included), which means that 2882 (i.e. 6.1%) connections per day less were added than in the period between July 2005 and July 2006, when 47 175 new DSL connections per day were recorded. Germany added more than 4.3 million new lines over the period, followed by France, the UK, Italy, Spain and Poland.

DSL Growth Trend since January 2003 (July 2007)



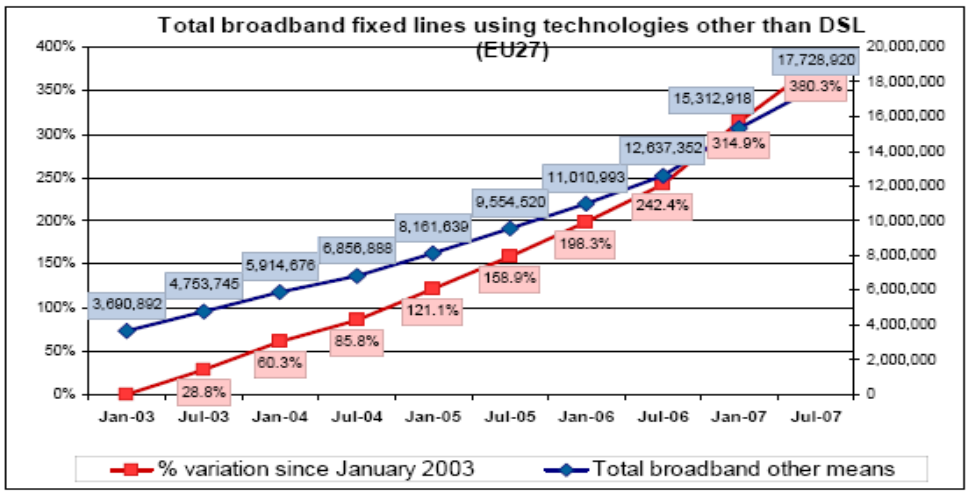
Source: European Commission

Growth Trend other than DSL

There were over 16 million (17.7 million with Bulgaria and Romania) broadband lines using technologies other than DSL in the EU as of 1 July 2007. Over 3.5million lines were added (5million with Bulgaria and Romania), which represents a 27.9% increase since 1 July 2006. Net additions in the period between July 2006 and July 2007 were higher than in the period between July 2005 and July 2006, when 3 082 832 new lines were sold, pointing at a solid growth of non-DSL segment.

Alternative operators provided 92.6% of these lines. Table below shows how the non-DSL broadband lines in the EU were distributed between the EU Member States.

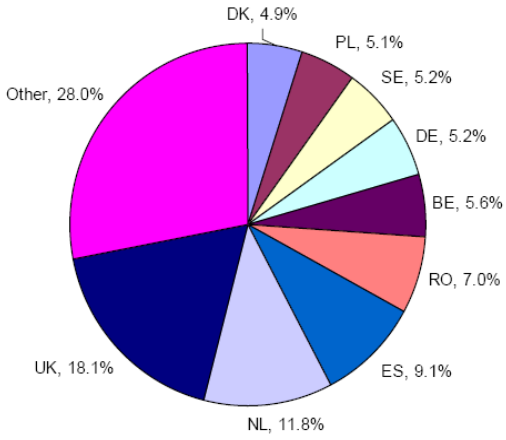
Growth trend since January 2003 (July 2007) other than DSL



The UK accounts for 18.1% of all broadband lines using other technologies, as shown in the figure below. The Netherlands has the second largest individual share, with 11.8%, followed by Spain, Romania and Belgium with 9.1%, 7.0% and 5.6% respectively. These five countries account for 51.6% of broadband lines in the EU in this category.

Broadband Access other than DSL

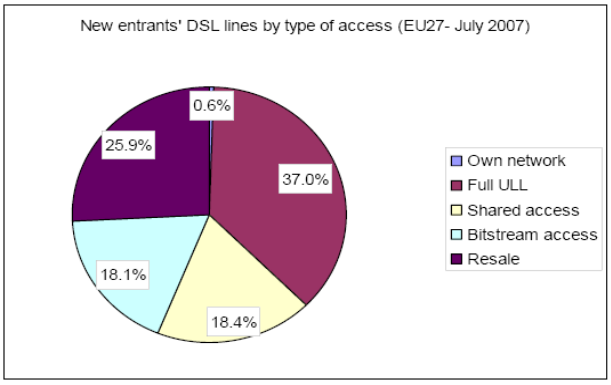
in European Union (July 2007)



Favored Access Technology by New Entrants

Figure below displays the type of access used by new entrants' to provide DSL lines to their customers. Local loop unbundling (fully unbundled lines and shared access) is the main wholesale access for new entrants with 55.4% of DSL lines, up from 45.9% in July 2006.

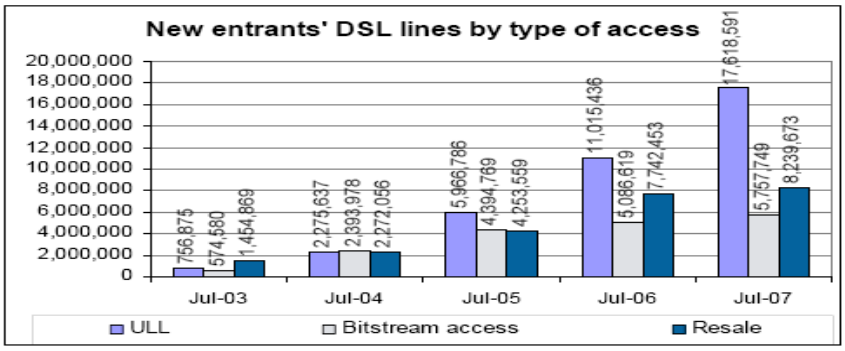
New entrants' DSL lines by type of access



Source: European Commision

New entrants continue to replace bitstream access (down by 3.1 percentage points since July 2006) for local loop unbundling in the provision of broadband services, as can be seen in figure below. Share of resale, which represents a type of access for low-investment intensive new entrants, has shrunken by 6.3 percentage points during the last year.

New entrants' DSL lines by type of access

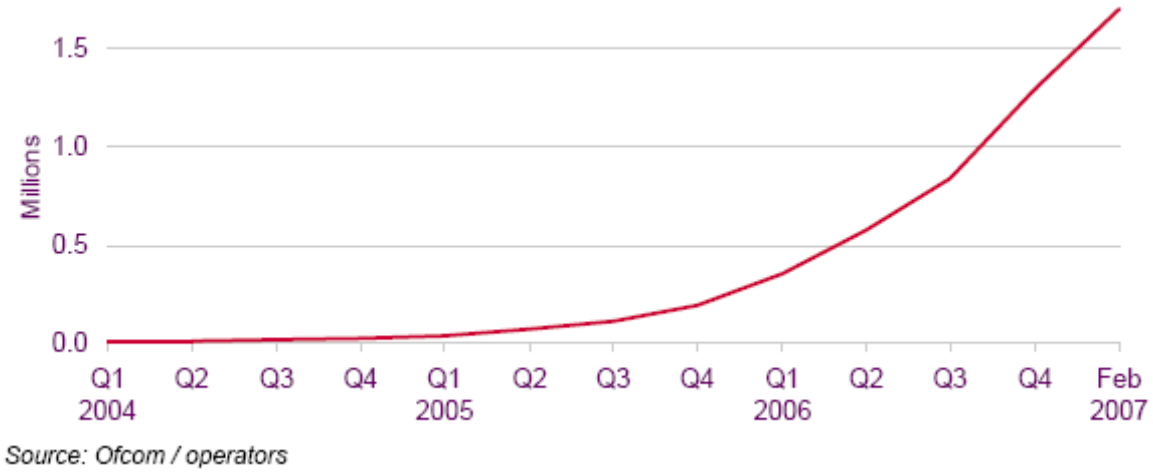


Source: European Commission

3. Trends in UK

DSL Growth Trend

In 2006 LLU gained significant broadband share in the UK. By the end of 2006 over 1,300 of BT's 5,600 local exchanges were LLU-enabled, extending the availability of LLU-based services to two-thirds of the UK population. The number of LLU lines increased by over 500% in 2006 to 1.3 million, accounting for 10% of all broadband connections (Figure below). Growth continued in early 2007, and in February there were more than 1.7m unbundled lines according the Office of the Telecoms Adjudicator.



Source: Ofcom / operators

LLU has become a major facilitator of product bundling in the UK, as it allows providers who operate in other communications sectors to enter the fixed telephony and broadband markets without the need for expensive access network investment. A number of LLU operators have been acquired by other communications providers as a means of extending their product portfolios so that they can offer a bundle of communications services.

As of 14 January 2006, 210,000 local loop connections had been unbundled from BT operation under local loop unbundling. Ofcom had hoped that 1 million local loop connections would be unbundled by June 2006. However, as reported by The Register, on 15th June 2006, the figure had reached only 500,000, but was growing by 20,000 a week. Ofcom announced in November 2006 that 1,000,000 connections had been unbundled. By April 2007, the figure was 2,000,000

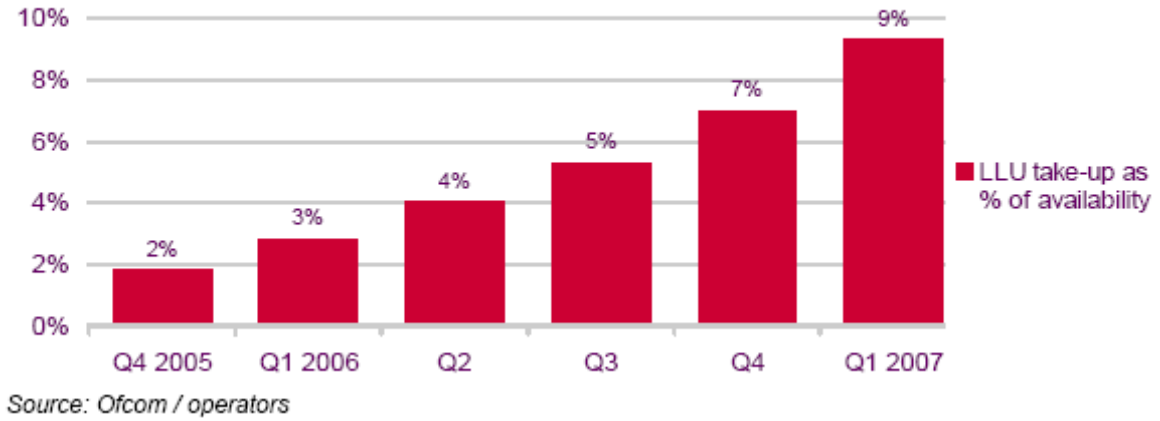
By June 2006, AOL UK had unbundled 100,000 lines through its £120 million investment making it the largest single LLU operator in the UK market

On 10 October 2006, Carphone Warehouse announced the purchase of AOL UK, the leading LLU operator, for £370m. This makes Carphone Warehouse the 3rd largest broadband provider and the largest LLU Operator with more than 150,000 LLU customers.

The latest LLU status of individual exchanges in the UK can be checked on www.samknows.com

Most LLU operators only unbundle the broadband service leaving the traditional telephone service using BT's core equipment (with or without the provision of Carrier preselect). Where the traditional telephone service is also unbundled, operators usually prohibit the facility where selected calls can be made using the networks of other telephone providers (i.e. accessed using a 4 or 5 digit prefix beginning with).

Figure 4.4 Proportion of premises in unbundled areas taking LLU services

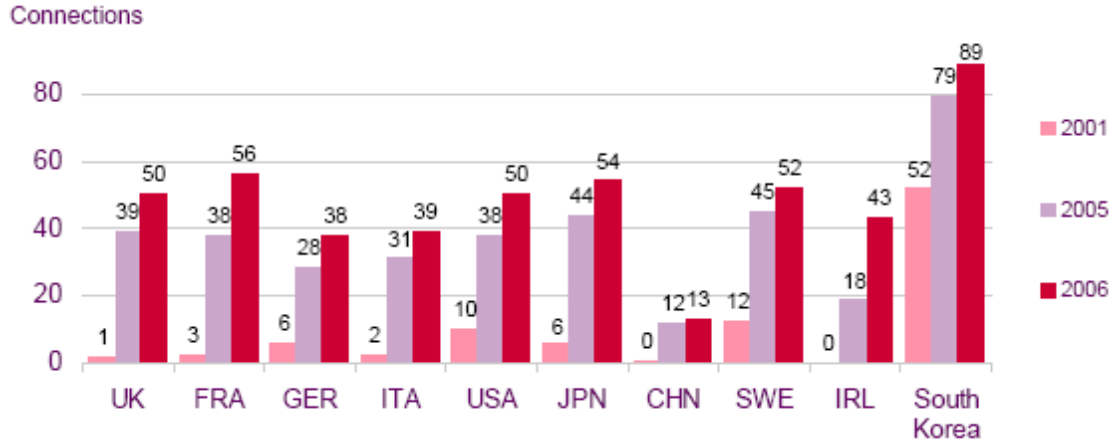


Source: Ofcom (Feb 08)

Growth Trend other than DSL

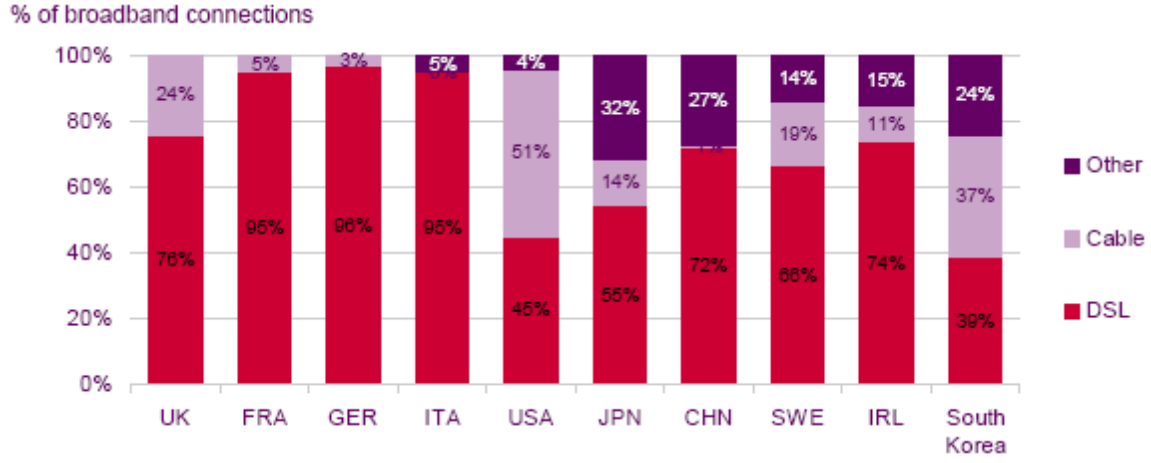
Figure below shows penetration levels in 2001, and demonstrates that, at that time, the UK lagged behind most other industrialized countries. The fact that the UK has since caught up with or passed many of its peers is attributable to a number of factors, including the development of the wholesale DSL market, the growth of cable broadband, and increased public awareness of broadband, stimulated by high levels of marketing by ISPs. Interestingly, even in 2001, South Korea had higher levels of broadband take-up than the majority of other countries around the world had achieved by 2006.

Broadband connections per 100 households



An examination of broadband access methods shows that by the end of 2006 just under a quarter of the UK connections were via cable (Figure below). This proportion was significantly higher than in many other European countries, and was due to the relatively high availability of the cable network in the UK. However, the UK's cable share has declined significantly, from around 60% in 2001, due to DSL-based broadband accounting for a large share of new subscriptions since then. Cable's share of connections was highest in the USA, with its long history of cable TV network. In South Korea, meanwhile, investment in very high-speed infrastructure, involving fibre to the kerb (FTTK) or fibre to the premises (FTTP), meant that by 2006 almost a quarter of connections were via these high-speed links.

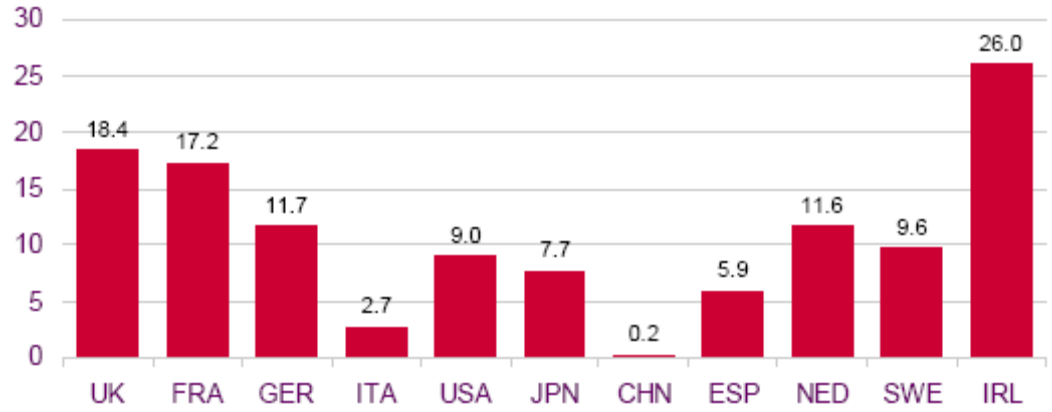
Broadband connection method, Q4 2006



Source: Point Topic/Ofcom

The availability of public wireless hotspots, which enable users to connect wireless devices to broadband in areas such as cafes, restaurants and airports, has grown rapidly in most industrialized countries since 2004. Figure below shows that the UK had a high availability of hotspots at the end of 2006, ahead of the USA, Japan, France and Germany, at 18.4 hotspots per 100,000 population. The absolute number of hot-spots in the UK has been growing rapidly over the past few years, driven by, among other factors, by legislative changes in 2002 and 2003 which enabled the use of some license-exempt bands for public WiFi access. Liberalization of some spectrum bands coupled with relatively high population concentration in the greater Dublin area might have also stimulated growth in Ireland, which had the highest availability of hotspots at the end of 2006 of the countries included in the analysis, at 26 per 100,000 populations.

Public wireless hotspots per 100,000 population, Q4 2006



Source: Informa

4. North American Trends

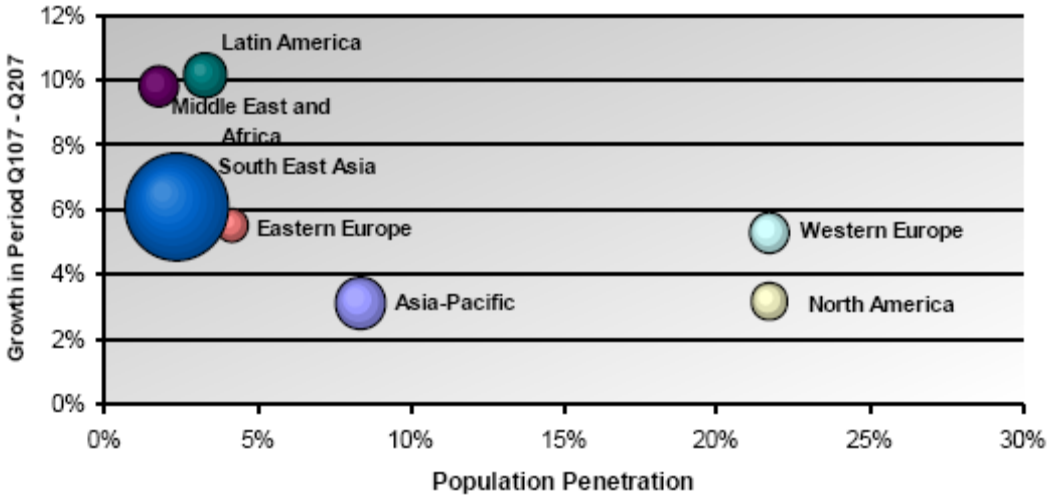
North America dominates cable modem up-take with a 54.25 per cent share in the market. This quarter, all regions aside from South East Asia, witnessed growth in their subscriber figures, though this growth was as low as .12 per cent in the Asia Pacific region. South East Asia experienced a negative growth rate of 2.05 per cent, bringing the region's total cable subscriber base down 26,500 to 1,265,500. Of the regions that did experience growth, all but Latin America experienced growth rates lower than that of Q1 2007. The exception, Latin America, grew its subscriber base at a rate of 13.09 per cent in Q2 2007, a quarterly rate that has risen by 5.25 per cent since Q1 2007.

On a regional level, Western Europe continues to hold the greatest market share of broadband subscribers with 27.58 per cent of the world's total. Western Europe is followed by North America with a 22.83 per

cent share and South East Asia with 20.73 per cent. The Middle East and Africa region continues to hold the smallest share with only 2.37 per cent of the total world broadband subscribers.

As can be seen from Figure 3 above, Western Europe and North America far exceed all other regions in terms of population penetration, with identical penetration rates of 21.70 per cent for Q2 2007. In Q1 2007, North America gained 3,531,542 additional subscribers. This figure fell to 2,176,832 in Q2 2007, causing North America's quarterly growth rate to fall 2.20 per cent to 3.14 per cent in Q2 2007. The annual growth rate for North America for the period Q2 2006 to Q2 2007 was 21.90 per cent.

Penetration & Quarterly Growth by Region



Conclusions

1. It is evident from the growth and technology trends around the globe that the DSL is the leading underlying technology supporting broadband growth around the globe despite the fact that it has experienced negative growth in some countries most recently.

2. DSL is most popular in Western Europe where almost every household was accessible through local loop which was in place for decades

3. Cable Modem is the second most popular underlying technology, globally, however it is the most popular in the countries with a history of cable television- again the reason is the availability of access to the customer premises.

4. Fibre deployment for delivery of broadband to the customer is the third most popular broadband access technology

Do you agree that:

a. Unbundling Network Elements (UNE-P) will scare away investment in Pakistan like it did in the US, if not please give your arguments

b. Sub Local Loop (SLU) is not a viable option for alternate service providers when using the incumbents infrastructure

c. Full Local Loop Unbundling is the most economical option for alternate operator to offer broadband services

IV. WTO Obligations

Some provisions of WTO telecommunications law can be read to require unbundling:

Sect. 5(a) of the GATS Annex on Telecommunications requires WTO Members to guarantee service suppliers "access to and use of public telecommunications transport networks ... for the supply of a service". New entrants argue that without LLU they cannot supply services such as ADSL.

Sect. 2.2(b) of the 1998 Reference Paper , to which some Members have subscribed, requires "sufficiently unbundled interconnection" with major providers. However, the Paper's definition of interconnection appears to exclude LLU.

Sect. 1 of the Reference Paper requires Members to maintain "appropriate measures ... for the purpose of preventing [major] suppliers ... from engaging in or continuing anti-competitive practices." New entrants argue that such practices include not giving competitors access to facilities essential to market entry, such as the local loop.

The question has not been settled before a WTO judicial body, and, at any rate, these obligations only apply where the respective WTO Member has committed itself to open its basic telecommunications market to competition. About 80 (mostly developed) Members have done so since 1998.

V. Market Conditions in Pakistan

Currently, there are twenty-seven NVCNS, twenty-three EIS and twenty-four DCNS and forty-three data service providers (DSP) in the country- well above one hundred in all. Both types of internet options are available. Dial up narrowband access is well entrenched and has a long history, in fact off line internet was started in the year 1989 when service provider would connect UUNet for exchange of emails while live internet started in year1994. Broadband access was also available to the customer around year-2000 when the incumbent entered into contract with four private companies to offer broadband services to PTCL customers over shared local loop under revenue sharing arrangements.

Host of cost effective options are available to individual customer in the dial up internet over the fixed line, with a subscriber base of 3.5million at the end of fiscal year 2006-07[9] against fixed line customer base of over 6.74million[10] i.e. 51.92% of the fixed line customers subscribe to dial up internet.

With a long history of internet in the country the actual penetration is very low where internet dial up access, a little more than 2%, is very low as compared to regional countries despite the fact that government policy dictates the incumbent to provide internet access to all its fixed line customers no matter in what part of the country they reside. Incumbent is further bound to extend access to nearest internet facility, irrespective of the physical distance, and to charge only one local call for the whole duration of dial up internet connection. The policy has paid dividend in that more than fifty percent telephone users subscribe to dial up internet. However the overall penetration is very low when compared within the region and the world.

History of Internet in Pakistan

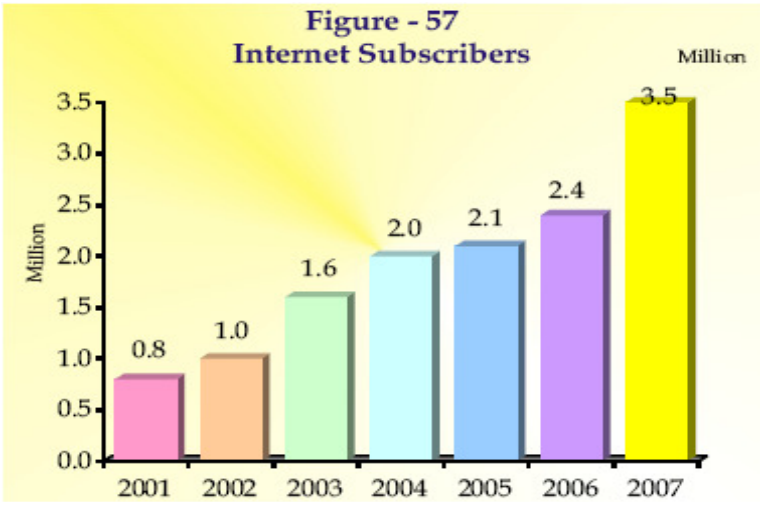
Store & Forward email through UUNet – 1989

Live Internet		1994
Broadband over Shared local loop		2000
Deregulation Policy	July	2003
Licensing in fixed line		2004
NVCNS Licenses		27
EIS Licenses		23

[9] PTA Annual Report 2007

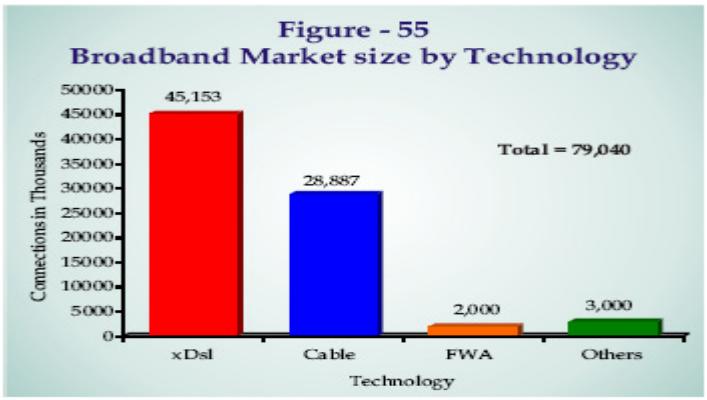
[10] Aggregate of wireline and WLL

DCNS Licenses	24
DSP Licenses	43
Total Data/Internet Licenses	**117**



Source: PTA Annual Report 2007

Whereas there were only 79040 broadband subscribers, all told, at the end of the previous fiscal year that translates into 2.25% of the dial up internet subscriber which is very small by any standards. However national broadband penetration is only 0.047%[11]. Following chart depicts broadband market size at the end of fiscal 2006-07.



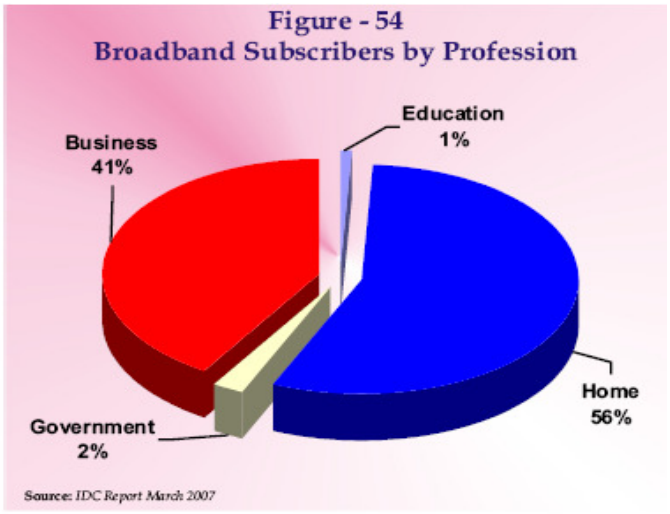
Source: PTA Annual Report 2007

Broadband growth has started showing some sign of healthy growth recently. The total number of DSL connections has jumped from 45153 lines in June 2007 to 78033 in Jan 2008 at a growth rate of 42.21% over a period of seven months. Sudden surge in the broadband growth may be attributed to FTTN (broadband connection on optical fibre network recently commissioned by the incumbent). Further, it appears that more

[11] Population taken is 165 Million

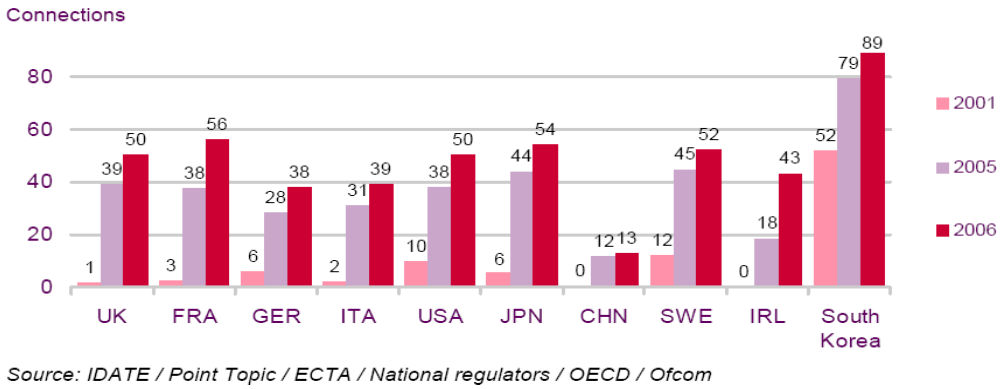
and more businesses having realized the role of broadband in the growth of their respective businesses, have started to move to electronic offices and increased use of the internet to achieve their business goals.

However businesses alone cannot bring about a cultural change in a society, broadband household is the major agent in transforming a society into a knowledge based economy. A split of the broadband market share indicates that household is the biggest broadband market around the globe. Following drawing lays down broadband market share across thirty countries of the world. Clearly home users make the major part of the broadband customer across the OECD, more than business, education and government combined together.



It is interesting to note that household penetration of broadband is much higher for the household as compared to overall broadband penetration in the top ten broadband country of the world- the pattern in these countries follows the pattern in the OECD countries as such true for the rest of the world. It is imperative for the spread of broadband in Pakistan that the offerings are attractive enough for the home user and is affordable.

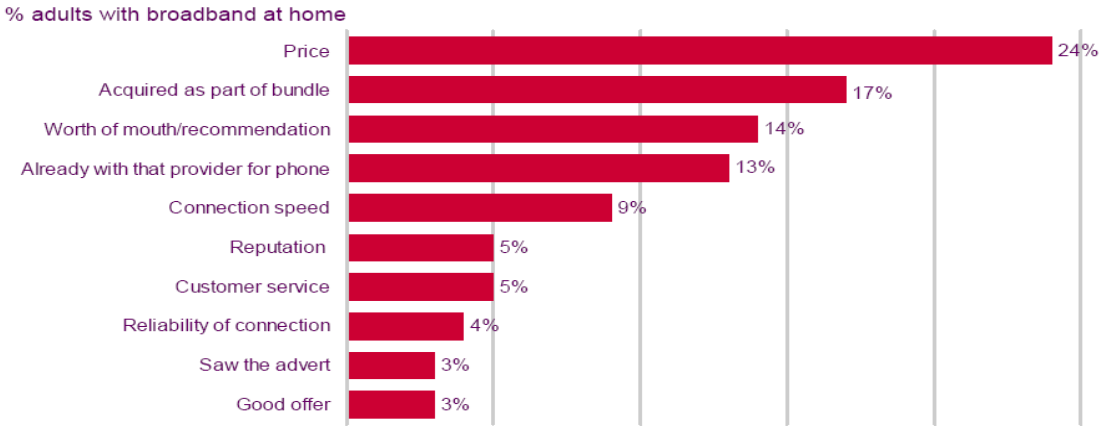
Broadband connections per 100 households



Source: IDATE / Point Topic / ECTA / National regulators / OECD / Ofcom

It is interesting to note that affordability is the single most important factor to allure the home user to broadband. Results of a research carried out by Ofcom are displayed in the following drawing. Price, I may be noted, is the biggest factor for choosing a service provider. The second biggest factor "Acquired as part of a bundle" may again be lumped with the first factor-Price. It may safely be assumed that Price counts for 41% cases while "connection speed, customer service & reliability" all bunched together account for mare 18%.

Factors influencing ISP choice - unprompted



Source: Ofcom research, February 2007

Broadband is basic platform for the delivery of bundled services over the internet to home user. Entertainment is the biggest driver of the broadband use in the household. Experience in UK can be cited as a good example where almost all the big service providers are offering bundled service. Some packages offered free broadband provision for the customers opting for the package. Following table sums up the bundled services on offer in the UK.

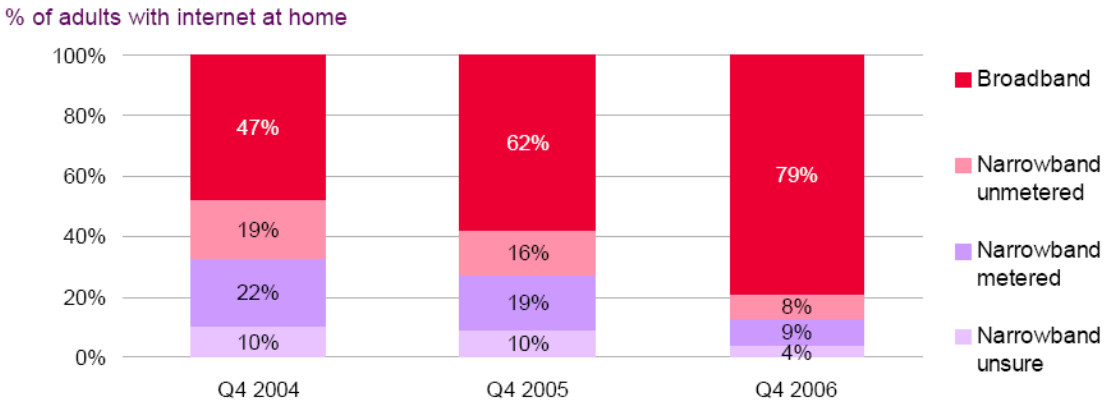
It is interesting to see that a number of service providers in UK have bundled their service together to give the customer value of his money. Following chart shows the service providers with the public offerings in the form of a bundle. Some companies offer broadband free of charge if the customer opts for specific bundle offered by the company.

Bundled products offered by major service providers, March 2007

Services offered	AOL	Be	BT	Orange	Pipex	Plusnet	Sky	TalkTalk	Tesco	Tiscali	Toucan	Virgin Media	Vodafone
Broadband and fixed, bundled or standalone	√	√	√	√	√	√	√*	√	√	√	√	√	√
Broadband and mobile			√	√				√	√		√	√	√
Broadband, fixed and TV			√				√*			√		√	
Broadband, fixed and mobile			√					√	√		√	√	√
Broadband, TV and mobile			√									√	
Broadband, fixed, TV and mobile			√									√	

In Q4 2006 around eight in ten adults who had internet access at home connected using broadband, compared to around six in ten a year ago. Un-metered narrowband packages accounted for a further 8%, while metered packages formed around 9% of connections. Around 4% were unsure whether their service was charged on a per-minute basis or whether they paid a flat monthly fee.

Internet Take-up in UK



Source: Ofcom research

It is important for broadband policy to create environment which makes it interesting for the home user to prefer broadband over the dial up connection even if it is costlier. With the growth the cost will eventually fall and broadband can compete with dial up in tariff as well, as has been the case around the globe.

There is no authentic internet subscriber data available categorizing the internet users. However it can very safely be assumed that all the broadband user (the assumption may be off the mark by 5-10%) are the businesses, big as well as small, while dial up users are all household users. The assumption cannot be long way off the mark since there is no incentive for home user to spend an awful lot of more money without any value addition.

The major reason for near exclusion of broadband from household is lack of real competition in the provision of broadband which has resulted in higher price for the household broadband. Another factor which has emerged recently, with the technological development around the globe, is non availability of bundled services in the market. It has to do more with the current policies i.e. Deregulation and Broadband Policy which were framed with monopolistic market conditions in the fore.

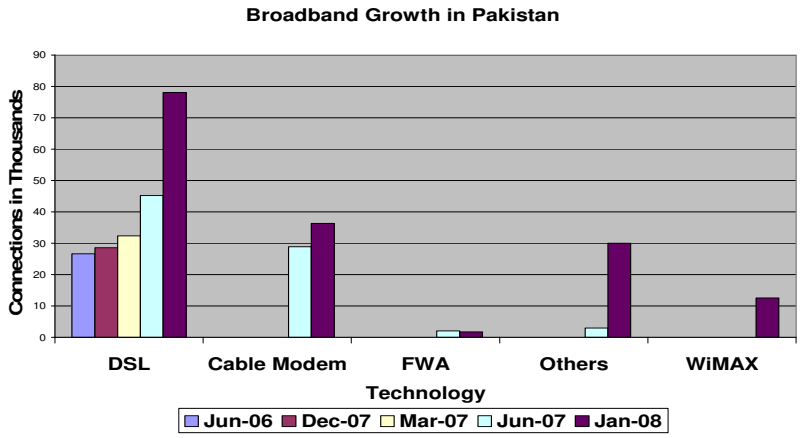
While the Deregulation Policy was actually framed under monopoly regime with a promised policy review after five years, now due, Broadband Policy concentrates more on the e-commerce and e-governance with no emphasis on household broadband which is major catalyst of attitude change for converting a society into knowledge based economy by generating interest in the new generation to access the knowledge available over the internet and learn for the world experience besides enjoying free access to entertainment.

Deregulation Policy review needs to support stimulation of household demand by authorizing the market players to introduce innovative bundled packages which interests the household with an affordable startup cost and reasonable tariff that replaces quite a number separate monthly rentals to one single rental with no or small addition over whatever the home user was paying for all the service he was getting i.e. dial-up internet, voice & entertainment (cable TV etc)

Bundled services present such a potential where entertainment, information and voice can present a package with an acceptable cost for the home user while remaining within a sustainable business model for the investor. Such a model would need supporting adjustments in the deregulation and broadband policy authorizing various categories of licensed service providers to be able to blend their services while remaining within the parameters of their respective licenses as well as business plans.

WiMAX introduced recently, has picked up well with 12000 customers in one quarter while it is reported that an order for the supply of 198000 customer premises equipment has further been placed. It appears that broadband growth in Pakistan is gathering momentum despite very difficult conditions.

Others in the chart below represent "Desi Cable" i.e. broadband connection provided by the cable TV operators (over a separate coaxial cable) in collaboration with an ISP, mainly in Karachi city where small operators are providing service within high-rise apartment blocks where the customer can also download video of his choice besides surfing the net thus adding some value over normal internet.



Monthly tariff for such a service (CATV plus Broadband) ranges from Rs: 300 to Rs:500, less than half the cheapest broadband connection in the market with the advantage of virtually no startup cost. This small business is developing into a real broadband service where small operators are joining hands to interconnect their customer bases, over optical fibre, to form a sizeable bunch to reap the benefits of economies of scale besides converting it into real broadband service.

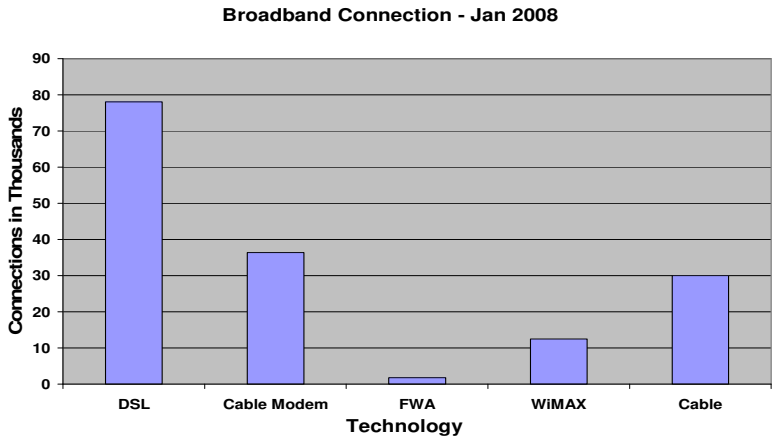
Figures quoted in terms of overall customer base for such a service in Karachi are widely apart i.e. ranging from 30,000 to hundreds of thousands, however no authentic figure is available. Some broadband operators in Karachi quoted startling figure of one

million customers on the Desi Cable, which is the unofficial name given to this service, which is very suspect. Bringing these service providers, basically cable TV operators providing internet services under a contract with licensed ISP need to brought in the mainstream for customer protection and further proliferation under properly regulated regime.

Total of Broadband connections at the end of January 2008 stood at 158689, split between various technologies is as under:

DSL	Cable Modem	FWA	WiMAX	Cable	Total
78033	36356	1800	12500	30000	158689

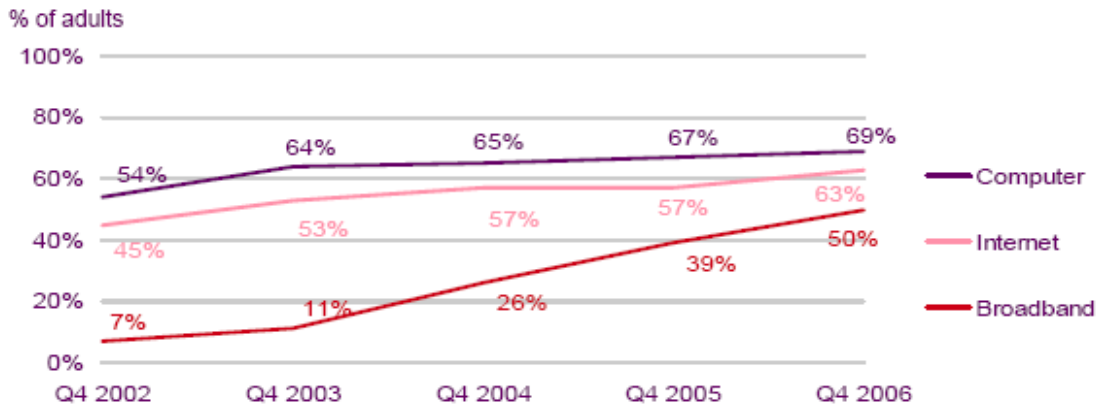
The split is further depicted in the chart below.



With 3.5 million internet subscriber and an overall base of 158689 broadband customers the conversion rate as compared to the rest of the world i.e. 4.53% is too low by any standards. The internet users have the wherewithal for broadband "the computer" however affordability for the same is not there.

For example internet penetration in UK is 64% against the backdrop of 71% household computer penetration (Q1 2007) indicating that the reason to buy household computer is to access the internet.

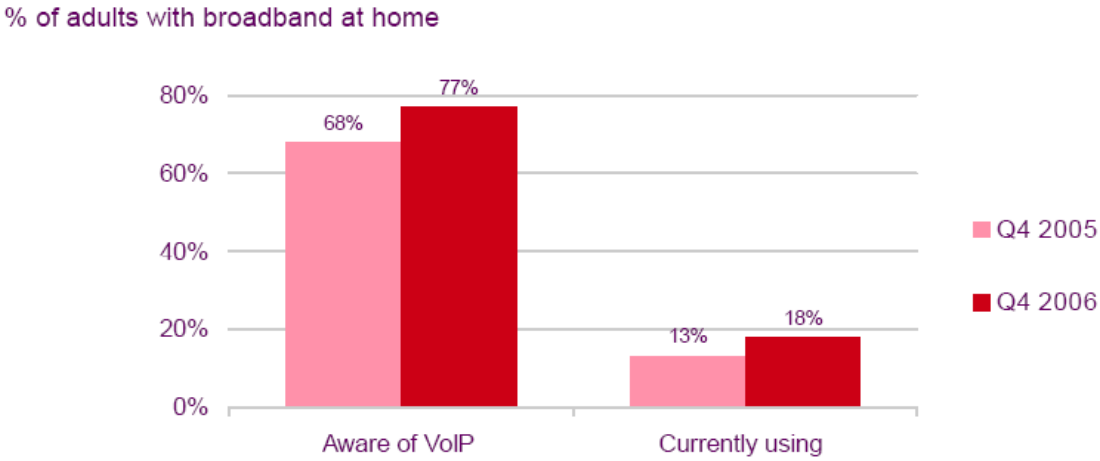
Computer, internet and broadband take-up



Source: Ofcom research

It is evident from the previous figures that al least 3.5 million internet users in Pakistan have the access to computer and most of them should have moved to broadband access in line with the rest of the world where broadband has in fact overtaken dial up access for example in UK 79% of the total internet connections are over the broadband whereas in our case only 2.24% of the dial up internet have broadband access.

Awareness and use of VoIP



Source: Ofcom research

Entertainment has drawn more and more customers around the globe and the economies of the scale has made it possible for some service providers to offer broadband free of cost- a supplementary to an existing service.

For example in April 2006 Carphone Warehouse, a UK based mobile phone retailer who acquired "AOL UK", announced a free broadband service for its customers taking a fixed line and calls package, and by December 2006 the company had already migrated 50% of existing TalkTalk fixed telephony customers onto its broadband service. Similarly "Pipex" offers a 2Mbit/s connection for £6.50 a month if bought with a voice call package; "TalkTalk", "Orange" and "Sky" offer free broadband when

taken with other fixed, mobile or pay-TV services; It is interesting to see where developed countries stand in terms of household penetration:

Present Broadband policy in Pakistan lays all the emphasis on the promotion of e-commerce, e- governance while only line sharing is mandated to the incumbent for the provisioning of data services by the new entrants. Full unbundling is not mandated. Further voice is not allowed which is so very essential for the provision of a host of entertainment services which can attract the household user to opt for broadband services.

It is evident from the above discussion that policy adjustments are required to empower the service providers to blend attractive offerings for the home users for the proliferation broadband.

A. Feedback from Current Providers

A small survey was conducted by the author across the country to collect firsthand feedback from current broadband service providers in the country. Only Islamabad, Lahore and Karachi were covered where service providers were invited in Regional PTA offices and face to face discussions held.

Feedback from the service providers is summed up hereunder:

IPLC Providers

1. The companies with landing rights who are providing international connectivity to fixed line operators lament that their rights are confined to landing point, forcing them to pay the cost of extending the connectivity to their customers up country.

2. With the present cost for provisioning IPLC does not make a solid business case for them. The cost of IPLC is keep being reduced in Pakistan whereas cost of laying submarine cable and its upkeep keeps rising. Further providing redundancy costs money to the IPLC provider which drags the margins further down making it impossible for them to enter into contracts requiring redundancy.

Broadband Service Providers

1. Unbundling of Towers (Sharing should be mandatory) Mobile, WLL and such other operators.

2. 3G & WiMAX Customer Premises Equipment (CPE) should be subsidized (Through tax holiday/USF support)

3. Incumbent's OFAN should be Unbundled.

4. FTTH should be Unbundled

5. Wi-Fi in the ISM Band should be allowed outdoors for setting up Hot Spots

6. Subsidy should be provided in infrastructure roll out (USF or Tax Rebate on Equipment)

7. Backhaul Sharing

8. Spectrum Sharing

9. Unbundling of LLU/SLU

10. Value Addition to Broadband

11. Data to be focused, voice is already common

12. DSL show stoppers (Dual fixed line rent,Inter-exchange/intercity media charges including ring charges, Colocation availability,power chages and availability issues, interface availability, copper quality support, infrastructure long term security issues

13. In case of full unbundling what will be support response to operators. NTC has too much influence but other operators will be handicapped while getting support from PTCL

14. Copper sharing is allowed but there is no media provisioning for other operators on OFAN

15. Bitstream wholesale model may be introduced (Customer premises issues should not be handled by PTCL otherwise this model will be unsuccessful due to PTCL support & cultural issues

16. In case customer is already on ONU, there is no policy to revert back on copper

17. All three options on unbundling should be opened but customer premises and first level support should not be in PTCL hands

18. PTCL/PTA need to ensure copper maintenance issues

19. PTA should control all the agencies for providing and maintaining communication facilities

20. PTA should ensure infrastructure security (ROW, Trenching, Cabinets installation)

21. PTCL is earning lots of revenue from DSL so there is no free drive on LL for DSL operators

22. Barrier in broadband penetration is copper quality support which is being maintained by the incumbent, this is the reason PTCL is running out of business in wired and launched V wireless

23. Unbundling of Dark Fibre

24. ISM band for Wi Fi hotspots 2.4 & 5.7G

The feedback from Broadband service providers is laid out as presented by them. While some of the demands /observations could be argued some of the observations warrant close examination, almost all these observations warrant policy review- Deregulation Policy as well as Broadband Policy, for example:

1 Value Addition to Broadband

2 Infrastructure Sharing including Towers

3 Opening of ISM Band for outdoor Wi Fi hotspots

4 Unbundling of local loop- Full unbundling

5 Dark Fibre Unbundling

6 Introduction of Bitstream wholesale model

7 Effective legislation on matters concerning ROW

8 Non discriminatory access to copper

9 Proper and timely maintenance of local loop

B. Deregulation Policy

Deregulation Policy 2003 for telecommunication sector placed following obligations on the incumbent operator, incumbent to extend interconnection facility to new entrants in the local loop and long distance & international market.

4.5 Interconnection

4.5.1 Both types of licensees will have the right to interconnection, leased lines and co-location facilities from the incumbents. Pricing of the incumbent services will be determined in accordance with the notified Rules, and subject to monitoring by PTA.

4.5.2 Pending the development by incumbent of unbundled cost accounts of services that are approved by PTA, incumbent's interconnection prices shall be based on international benchmarks.

4.5.3 The initial interconnection prices will be notified by PTA by October 2003. Lead times for provision of interconnect facilities to new-entrants by incumbent (inter-alia) shall be set out in a "Reference Interconnect Offer" to be made available by PTA, and will be in accordance with international benchmarks.

4.6 Obligations on incumbent

4.6.1 In order to facilitate market liberalization, incumbent, within a stipulated time frame, is obliged to:

a) Prepare all transit and tandem switches for interconnection. Implement within six months after policy approval, all needed upgrades in the transit switches to the capacity orders submitted by new entrants. incumbent shall not be required to implement upgrades in respect of orders not accompanied by pre-payment of 3 months port cost. incumbent shall pay needed penalties in case of delay in providing ordered PoIs, to be determined by PTA.

b) Prepare 50% (measured by lines in service) of local Main Switching Units ("MSU") for interconnection within one year. The remainder to be done in two equal stages within the subsequent two years

c) Enable subscriber lines on all digital local switches to perform Indirect Access (call-by-call carrier selection) for 22 digit numbers within one year.

d) Enable all subscriber lines to perform Indirect Access

e) Enable all subscriber lines to perform carrier pre-selection

4.6.2 Incumbent shall upgrade all local switch software to allow automatic insertion of Access Code before the numbers dialed by customers of LDI licensees (carrier pre-selection).

4.6.3 Incumbent shall publish cost-based price for restoration, in the event of fault on the non-self-healing cable, to the same availability standards as it currently enjoys.

4.6.4 Unbundling of service and cost accounting information should be done based on the principles of transparency, orientation, and allocation base on activities and related cost drivers. They shall be sufficiently detailed to allow clear identification of (a) activities related to interconnection - covering both interconnection services provided internally and interconnection services provided to others; and (b) other activities, so as to identify all elements of costs and revenues. Details of the basis of their calculations and the allocation methods used shall be provided, including an itemized breakdown of fixed assets and structural costs. Sufficient records must be kept to allow independent audit of these cost accounts.

4.6.5 PTA will issue a "Reference Interconnection Offer" (RIO) to be used as the default interconnection offer for interconnection with incumbent pending determination of LRIC based pricing. incumbent can implement amendments to the interim RIO, subject to the prior approval of PTA.

4.6.6 Incumbent shall continue to be obliged, until end 2008, to install exchanges and lines in rural / under-served areas at the same annual average rate as it achieved during the exclusivity period, and in any case no fewer than 83,000 new lines per annum. PTA will verify this on year-by-year basis.

4.6.7 Wherever incumbent faces competition and when the competitors price their services below the incumbent regulated rate, incumbent will be at liberty to offer discount in the region / area concerned to meet the challenges of competition.

4.7 Pricing Regime

4.7.1 PTA will continue to regulate incumbent's rates and services in the public interest, as per the notified Rules. As the market for particular services become effectively competitive, PTA shall reduce the regulatory burden on incumbent in respect of such services, while maintaining appropriate anti-competitive safeguards.

4.7.2 PTA will prepare detailed pricing framework for new fixed-line telephony licensees. PTA will also have the power to determine as to which of the licensees hold Significant Market Power (SMP). Licensees who are not SMPs will not be subjected to any tariff regulations. It may be noted that competitive telecom market may result in differential regional prices as against current uniform rates for various fixed-line services across the count.

4.7.3 Further, as already stated, under the APC regime, a significant portion of settlement rates for international traffic will be transferred to Local Loop licensee.

As per interconnection clause a detailed interconnection framework under Reference Interconnect Offer has been developed by incumbent and duly approved by PTA and prices worked out in consultation with the industry, under the supervision of PTA. The prices are based on international benchmarks. Incumbent is working on the Long Run Incremental Cost model.

Prices for collocation are fixed by the regulator as also the other costs i.e. power etc.

Deregulation Policy does not mandate local loop unbundling by the incumbent operator

C. Broadband Policy

Broadband Policy was announced by the government of Pakistan in Dec 2004 with following objectives:

Broadband Policy Objectives

The Broadband policy is designed to achieve the following objectives:

1. Spreading of an affordable, 'always on,' broadband high speed internet service in the corporate/commercial and residential sectors across Pakistan.

2. Encourage the entry and growth of new service providers while stimulating the growth of the existing ones at the same time.

1. Encourage private sector investment in local content generation and broadband service provision.

Policy on Broadband in Pakistan lays all the emphasis on e-commerce, e-governance and the like- all the applications away from home use. Further it does not allow voice over the internet stopping stand alone internet service providers to come up with offerings attracting the home user.

D. Reference Unbundling Offer

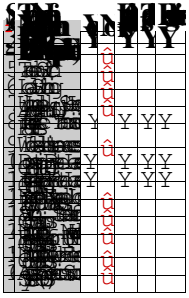
Incumbent will be required to prepare a reference unbundling offer once policy on unbundling is announced.

Quite a few procedures and regulations related o unbundling are already in place where Carrier Selection and local loop unbundling (line sharing only) is implemented. Most of the issues are common to full local loop unbundling and line sharing which makes implementation relatively easy.

Following table depicts overall regulatory situation on ground in relation to local loop unbundling:

Regulatory Framework already in place for Unbundling in Pakistan

S. No	Type/Name of Network Element	Unbundled		Detailed Procedures	Tariffs	Regulations
		Yes	No			
1	Unbundled network elements		✘			
2	Local loop unbundling (FLL)		✘			



		Unbundled			

S. No	Type/Name of Network Element	Unbundled		Detailed Procedures	Tariffs	Regulations
		Yes	No			
17	Signaling Systems and Call-Related Databases		✘			
18	Dark Fiber		✘			
19	Co-location	**Y**		**Y**	**Y**	**Y**
20	Call-by-Call Carrier Selection	**Y**		**Y**	**Y**	**Y**
21	Carrier Pre-Selection	**Y**		**Y**	**Y**	**Y**
22	Directory Information	**Y**		**Y**	**Y**	**Y**
23	Co-location (MDF)	**Y**		**Y**	**Y**	**Y**
24	Power	**Y**		**Y**	**Y**	**Y**

Do you agree with:

a. ***Conclusion that household is the major driver for broadband penetration***

b. ***Role of household broadband as nursery towards knowledge based economy***

VI. Options and Recommendations

A. Key issues to be addressed

In view of the fact that unbundling policy was not considered in deregulation policy and the assurances extended on liberalization of fixed line sector for consistency in the policy till first review after five years, almost up, now is the appropriate time to firm up the options on LLU to be considered for inclusion at the time of deregulation policy review.

Following considerations merit a very close look:

- Which unbundling option, if any, to adopt?
- What is the appropriate pricing model for the selected option?
- What are the implications for the incumbent?
- What are the implications for PTA?

B. Unbundling options

There are five unbundling options. Local loop unbundling (line sharing) is not considered since already implemented:

1. Unbundling of network elements
2. Local loop unbundling (FLL)
3. Sub Loop Unbundling
4. Wholesale bitstream access
5. No unbundling

To align with the National Regulatory Framework (NRF), the main policy objectives of the PTA, listed below, will serve as primary evaluation criteria for the unbundling options:

1. How does the option affect the infrastructure
2. How does the option affect the increase in teledensity?
3. How does the option contribute to availability of high quality innovative ICT services?
4. How does the option help bridge digital divide?

5. How does the option create competition in the ICT sector?

A further evaluation criterion, to be considered in conjunction with the policy objectives is:

How practical is the option to implement?

C. Analysis of options

The methodology used for option analysis is to evaluate each unbundling option according to the 5 criteria listed above. This is followed by a table summarizing the experiences of other countries that have implemented unbundling.

1. Option 1: Unbundled Network Elements (UNE)

Increase teledensity: Negative

This option will probably lead to a decrease in overall network investments. The incumbent will cut back on network investment because its investments are not protected from the new entrants. The new entrants, on the other hand, will likely choose to rent facilities instead of incurring high capital investments. In the case of US, which implemented UNE in 1996, total network investment fell in the years 2000 to 2003. In 2004 and 2005, the FCC made a series of announcements to remove most of the unbundling obligations. This was followed by new network investment announcements from the operators. (refer to history of LLU)

Availability of affordable high quality innovative ICT services: Negative

UNE is likely to introduce competition which will lower retail cost of data services. However, there is little chance for the introduction of innovative technologies as new entrants, using incumbents network elements remain tied down to its capabilities with no chance of upgrade to their requirements for the introduction of new features/services. New entrants may be able to innovate on content, pricing and service packages. However, as borne out by the experience of some other countries, this might be short-term in nature as UNE impairs investments in the network infrastructure, which is necessary for a sustainable competitive market structure.

Further unbundling network elements is very costly and difficult to implement

Bridging the digital divide: Negative

This option does not contribute to bridging the digital divide as new entrants will likely focus on serving the most profitable customers in the urban areas (cherry picking). This will make the cost of access in urban areas lower than rural areas, widening the digital divide. Take the US as example, as of December 2004, the new entrants (also known as competitive local exchange carriers or CLEC in US) had nationwide market share of 18%. However, the breakdown of market share by states shows that the CLEC have higher market share in more urbanized states while taking little or no market share in the less urbanized states. This is shown in Table 5.1 below.

Table 5.1: CLEC market share by states

Top 3 states in terms of CLECs' market share		**Bottom 3 states in terms of CLECs' market share**	
State	**CLECs' market share**	**State**	**CLECs' market share**
Rhode Island	35%	Virgin Islands	0%
New York	30%	Montana	4%
Michigan	26%	Idaho	7%

Again broadband penetration rate in the US urban and suburban households is almost double the rate in rural areas. Rural Internet penetration has remained roughly 10 percentage points behind the national average. In 2006, 25% of rural adults reported a home broadband connection compared to 44% of urban adults.

Competitive ICT sector: Positive

UNE will remove significant barriers of entry for the new entrants namely high sunk cost and economies of scale. This will enable the entrants to be competitive in a shorter period of time.

Practicality of Implementation: Negative

UNE is difficult to implement due to three major factors; **regulation, cost of implementation** and **technology upgrade**. Details for each area are listed as follows:

1. **Regulation**

PTA effort to regulate UNE will be enormous. Key regulatory tasks include:

- **Elements to be unbundled –** PTA has to decide on which elements to impose unbundling obligations. The common practice of other regulators is to identify those elements that are essential for service provisioning but at the same time not economical for new entrants to replicate. However, the nature of the telecom industry heavily favors economies of scale and put cost disadvantages on any new entrants. Many network elements will appear to be uneconomical for new entrants to replicate. PTA will have to decide what level of cost disadvantage will be the threshold to justify unbundling. From the experiences of the other countries, this often involves a long negotiation process with the incumbent.

- **Fair pricing** – PTA will need to determine a pricing level that will not discourage operators from investing and yet be attractive enough for new entrants to offer services using the unbundled network elements. In general, regulators have been using the Long Run Incremental Cost (LRIC) method, using an assumed efficient operator to calculate the cost base. This requires

detailed workings of cost of each unbundled element by incumbent and approval by the PTA. In the end, it is difficult to determine this ideal pricing level that is fair to incumbent yet attractive for the new entrants. From the experience of US, the pricing methodology proposed by the FCC has been constantly challenged by the incumbents and resulted in costly and long drawn lawsuits.

- **Detailed rules** – Rules and regulations on the unbundled network elements need to be clear, specific and up to date. The large number of elements and rapid changes in technologies make this a difficult task. For example in Singapore, the incumbent's unbundling offer includes the specific technical characteristics of jumper wires to be used and how the jumper wires should be installed to connect to the new entrants network. This has to be done for all network elements to be unbundled and the associated elements.

2. Cost of Implementation

To achieve unbundling of network elements, incumbent will need to provide physical separation of its network elements which will be very costly to implement. Major cost items include:

- Installation of equipment for separation of network elements
- Providing appropriate co-location space

Unbundling of network elements also requires significant changes to the workflow of incumbent which will be a significant cost burden on the company. Key business processes that will be impacted include:

- Provisioning of information on the unbundled elements to new entrants
- Business process for new entrants to request for unbundled elements
- Response time for requests
- Request approval process
- Delivery process
- Fault reporting and maintenance

3. Technology upgrade

Technologies deployed in the industry changes at a rapid pace and are upgraded constantly. All the detailed regulations and workflow may become obsolete when the operators adopt new technologies such as Next Generation Networks (NGN). Continual updates of the unbundling rules are required to keep them relevant, which requires significant effort from both incumbent and the regulator.

2. Option 2: Local Loop Unbundling (Full unbundling)

Increase Teledensity: Positive

New entrants are not incentivized to invest in alternative local loop technologies such as Broadband Wireless Access or FTTx and thus do not have to invest a whole lot of big money in infrastructure roll out before going into operation, but they have to build their own data and voice network, with comparatively smaller investment and launch the service through unbundled local loop. Besides it will reduce "time to market" drastically.

Availability of affordable high quality innovative ICT services: Positive

New entrants can offer their own data services (and voice for Full Unbundled Access) using incumbent last mile. New entrants are likely to create competition at the retail level which will bring overall price of ICT services down. Further new entrants can launch innovative services riding over the IP without looking towards the incumbent for any upgrades.

Bridging the digital divide: Positive

As in the case for UNE, new entrants are likely to cherry pick the most profitable region to offer their services, which are the urban areas, to start with. However, with the saturation of urban areas new entrants are likely to target relatively less attractive areas as well since the cost of rental for local loop does not escalate for them. With the possibility of hiring the backhaul over the fibre new entrants can utilize their core network installed for the urban areas and may well offer the services in less attractive areas once they get going. Such a scenario may well help bridge the digital divide.

Competitive ICT sector: Positive

The local loop is the most expensive network element for the new entrants to replicate. Allowing them to tap on the incumbents' local loop will enable them to compete with the incumbent in a shorter period of time.

Practicality of Implementation: Positive

Despite being less demanding than UNE, implementation of LLU still requires significant effort from the PTA and industry players to implement. Most of the considerations that apply to full network elements unbundling also apply to LLU. Fortunately, one form of unbundling (line Sharing) is already implemented and most of the regulatory framework already in place, very little extra effort is required as far as procedures and regulatory framework is concerned. However a lot of effort will be required to convince the incumbent to unbundle the network with speed.

Although line sharing has not led to massive broadband penetration however it has proved its relevance to knowledge based economy. The recent surge in DSL connections despite cost barrier was possible only for the introduction of Line Sharing. Following regulatory framework is already in place:

1. **Regulatory efforts**

   - Determination of pricing
   - Detailed rules

2. **Cost of implementation**

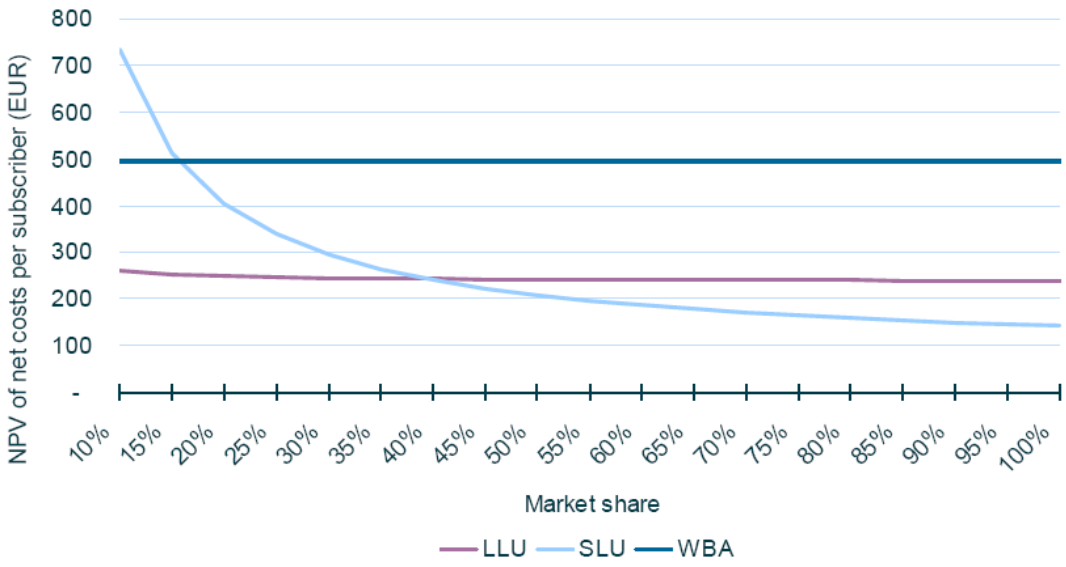
   4. Installation of network equipment (e.g. DSLAMs)
   5. Changes to business processes of incumbent

3. **Technology upgrades**

   6. Although local loop technologies are changing rapidly i.e. Broadband Wireless Access, FTTx and WiMAX etc. local loop still is the cheapest option for startup broadband connection when considering the cost of customer premises equipment.

3. Option 3: Local Loop Unbundling (Sub Loop Unbundling)

SLU is subject to very strong economies of scale, which are much more significant than for LLU (see Figure below).



Source:Analysys

This contributes towards the difficulty of the business case for other authorized operators who may want to hire last mile (copper) from the incumbent The largest costs faced by new entrants in deploying SLU are the charges for line rental, co-location at the street cabinet and the backhaul link to the MDF. In all three cases, it seems unlikely that competition will provide lower prices than those presently available.

Credible sub local loop products are still under test in the developed countries.

It further carries the risk of decline in further investment by the incumbent if obligated to open the fibre to the competitors for back hauling their customers.

Increase Teledensity: Negative

As part of its development of a next-generation network (NGN), quite a few operators have laid optical fibre network in the metropolitan cities in the country while the incumbent has deployed extensive optical fibre network in twelve major cities. Mandating sub loop unbundling may help increase teledensity since the localities covered by the incumbent coincide with the legacy local loop.

Availability of affordable high quality innovative ICT services: Positive for innovative high quality ICT services; Negative for affordable service

New entrants can offer their own services and bundle various services together to offer exciting packages without any restraint using incumbent last mile and likely to create competition in the introduction of innovative ICT services riding over the internet. However the cost of the backhaul and the collocation at cabinet level may be prohibitive unless broadband gathers a critical mass with a very high penetration rate where new entrant can justify the investment required for cultivating a small number of customers at cabinet level.

Bridging the digital divide: Negative

As in the case for UNE, new entrants are likely to cherry pick the most profitable region to offer their services, which are the urban areas, to start with; more so with the cost higher cost of SLU as compared to LLU

Competitive ICT sector: Negative

With strongest economies of scale for sub loop unbundling and credible products yet to be developed role of SLU in stimulating competition are suspect in the near future.

Practicality of Implementation: Negative

Despite being less demanding than UNE, implementation of SLU still requires significant effort from the PTA and industry players to implement. Further mandating the optical fibre network for unbundling may scare away further investment by the incumbent.

4. Option 4: Wholesale Bitstream Access

Increase teledensity: Negative for local loops, positive for other network elements

New entrants are not incentivized to invest in alternative local loop technologies, as such but they have to build their own data network to use bitstream access.

Availability of affordable high quality innovative ICT services: Positive

Wholesale bitstream access is fast to rollout as it does not require extensive co-location of equipment. This will allow retail competition within a short timeframe.

Bridging the digital divide: Negative

As new entrants are fully reliant on the incumbent for the last mile and not required to co-locate any equipment, they can only offer the same coverage as the incumbent.

Competitive ICT sector: Positive

Mandatory wholesale has proven to be a useful tool for new entrants in many countries. In UK, for example, wholesale lines account for 46% of market share for all broadband lines- the most popular type of broadband line by far. In Australia, the combined market share of all DSL resellers should overtake the market share of Telstra in near future.

Practicality of Implementation: Positive

Wholesale bitstream access has been successfully implemented in many countries. Since it requires no co-location of the new entrants' equipment with the incumbents, service rollout can be very fast. Regulatory effort and cost of implementation can be further minimized by including bitstream as an Interconnection Service and incorporating it in the overall RIO. Considering the case of New Zealand, which decided to implement bitstream access in December 2003; by November 2004 (in less than 12 months), the incumbent Telecom New Zealand was able to offer commercial bitstream access. By December 2005, wholesale bitstream access accounted for 22% of Telecom New Zealand's residential broadband lines. (Refer to benchmarking of New Zealand in Annex I for more details).

5. Option 5: No unbundling

Increase teledensity: Positive

New entrants will be required to invest in their own infrastructure including the last mile access. This will potentially introduce alternative last mile technologies such as Broadband Wireless Access and FTTx.

Availability of affordable high quality innovative ICT services: Negative for affordability, positive for high quality innovative services

As the new entrants invest in new technologies, it is likely that new innovative services can be introduced. Rollout of alternative networks, however, will increase the capital expenditure of the new entrants which will put upward pressure on pricing.

Bridging the digital divide: neutral

The PTA can mandate rollout obligations to the new entrants to provide universal coverage.

Competitive ICT sector: Positive

In the short term, the new entrants are not likely to offer any competition to incumbent as they rollout their networks. As the alternative networks are built, the new entrants will be able to offer facilities based competition. This can be observed from countries having alternative last mile infrastructure for Cable TV, e.g. Singapore where cable accounts for 46%[12] of total broadband market.

Practicality of Implementation: No implementation

"No unbundling" does not require additional efforts from the PTA or incumbent.

Table 5.2: Summary of the options analysis

Options	Increase teledensity	Affordable innovative services	Bridging digital divide	Competitive ICT sector	Practicality of Implementation
1. Unbundled network elements	Negative	Negative	Negative	Positive	Negative
2. Local loop unbundling	Positive	Positive	Positive	Positive	Positive
3. Sub Loop Unbundling	Negative	Negative	Negative	Negative	Negative
4. Wholesale bitstream	Negative	Positive	Neutral	Positive	Positive
5. No unbundling	Negative	Positive	Neutral	Negative	No implementation

Unbundling experiences of other countries

Table below summarizes the unbundling experiences of other countries. It is obvious from the table that unbundling network elements led to phenomenal cut in infrastructure investment in the US and FCC was forced to reverse the decision, UNE as such is no unbundling option any more. Similar results were witnessed in Canada.

Summary of unbundling experiences of other countries

Country	Year of imple-mentation	Type of unbundling	Results/remarks

[12] Source: IDA Singapore

Country	Year of imple-mentation	Type of unbundling	Results/remarks
US	1996	UNE	New entrants gained 18.5% of local access lines as of Dec 2004 Network investments fell in the years 2000 to 2003 Constant legal challenges from incumbents Reversed most unbundling obligations by 2005 which was followed by new commitments from the operators to invest in networks
Canada	1997	UNE with a 5 year sunset clause for some elements	New entrants gained market share of 3.3% for local residential lines and 12.4% for local business lines as of Dec 2004 Cable operator provided more competition to the incumbents compared to new entrants using unbundled network elements
Singapore	2001	UNE	The second fixed line operator, StarHub, acquired the local cable TV company and provide data services through the cable networks Cable accounts for 45.6% of broadband lines as of Dec 2005 Pacific Internet, the largest ISP that offer broadband services through unbundling, has only 1.3% market share as of Dec 2005
UK	2000	LLU and bitstream	250,000 lines fully unbundled as of Jan 2006, which is less than 1% of total fixed lines Wholesale bistream access accounts for 46% of all broadband lines in UK, the most dominant type of broadband lines by far
Australia	2000	LLU and bitstream	103,000 lines fully unbundled as of Dec 2005, which accounts for <4% of total broadband market Combined market share of all DSL resellers using Telstra bitstream services is projected to account for 46.7% of all broadband lines

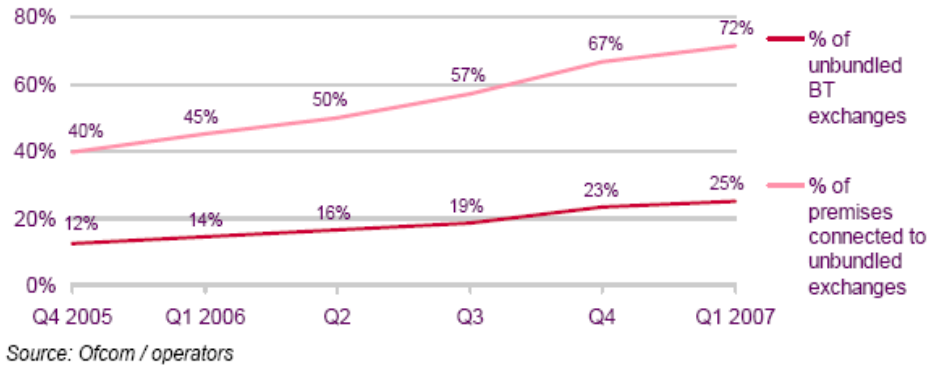
Country	Year of imple-mentation	Type of unbundling	Results/remarks
New Zealand	2004	Bitstream access only	Learnt from the experiences of the other countries and impose only bitstream access obligations using retail minus pricing Bitstream lines account for 22.7% of Telecom New Zealand's broadband lines 12 months after implementation
Jordan	2005	Bitstream access only	Issued public consultation on draft Unbundling policy in 2004 where bitstream was the only mandated unbundled service New Interconnection instructions issued in Jan 2005 to include bitstream access as an Interconnection service, no other forms of bundling mandated Awarded second fixed license to Batelco Jordan in May 2005

Source: ADL analysis

D. Recommendations on unbundling option

A major driver of recent falls in the cost of telecoms services in UK has been the accelerated rate of exchange unbundling. During 2006 the proportion of UK premises able to receive fixedline and DSL broadband services based on local loop unbundling (LLU) increased from 40% to 67% and by the end of March 2007 this figure had further increased to 72% (Figure below).

Proportion of unbundled exchanges and connected premises



Source: Ofcom / operators

This level of availability was achieved through the unbundling of just 25% of BT's 5,600 local exchanges. The high upfront cost of unbundling an exchange (related to the purchase and installation of equipment in an exchange) along with the relatively low cost associated with connecting each additional customer means that LLU

operators have tended to locate equipment in exchanges connected to a large number of premises. As exchanges covering a larger number of delivery points tend to be found in more densely populated areas, LLU availability is usually higher in urban than in rural areas.

This can result in lower-priced fixed telecoms services being more widely available in urban areas; unbundling exchanges gives operators control over more of the value chain and access to economies of scale not available when using incumbent's wholesale tariffs. They are then able to pass these savings on to consumers.

New entrants are not incentivized to invest in alternative local loop technologies such as Broadband Wireless Access or FTTx, but they have to build their own data and voice network to use the unbundled lines.

There are two main reasons for broadband providers to pursue LLU:

• It offers more control over the services that they can offer. This allows greater product differentiation and increases the number of services available to consumers.

• It provides control over a greater part of the value chain and exposes more of the underlying cost structure. This gives the provider a greater opportunity to introduce efficiency improvements and allows greater flexibility in tariffs.

LLU requires significant up-front investment in each local exchange for the operator to be in a position to serve the fist customer. For instance, space preparation, equipment and backhaul installation. These costs can vary significantly depending on the configuration however the overall costs are substantial for a new entrant and needs strong financial backing.

Subsequent costs are predominantly driven by the number of lines unbundled, e.g. modem-port costs, line connection costs, annual loop rental charges per line for full access or shared access and operational costs such as power consumption and billing. Therefore, in order to achieve a 'low' average cost per end user, at a given exchange, it is necessary to achieve a 'high' number of unbundled lines.

Clearly, there is a greater possibility of achieving a 'high' number of unbundled lines in a larger exchange, that is, an exchange that serves a large number of consumers. It is for this reason that LLU is predominantly being used in large exchanges, which are generally located in densely populated areas.

The combination of high initial cost and the need to achieve 'high' volumes means that in general LLU will be attractive to larger players who have access to capital. However, irrespective of size, some operators prefer the option of purchasing wholesale products instead of using LLU. Also, if an operator uses LLU only in densely populated areas, it may continue purchasing wholesale products from the incumbent outside these areas to achieve national coverage.

The option that best satisfies overall PTA's objectives is Option 2: Local Loop Unbundling. However, to achieve positive results for this option it is important that

retail unit is separated from the incumbent on the lines "Openreach" was created from BT. In the interim, the best option is Option 3: Wholesale Bitstream Access to introduce competition at the retail level quickly without incurring too much cost. From international experiences, bitstream access has also been more successful than other types of unbundling PTA prefers that a combination of these options, Whole Bitstream Access in the short term, with a sunset clause (time limit), coupled with Full Unbundling will speed up competition at the initial stage and be reflected positively on the broadband penetration in the urban areas.

One type of Local Loop Unbundling (line sharing) is already in place for a number of years now. Although the option has not lead to significant broadband penetration at least it has created necessary awareness about the veracity of broadband in creating a knowledge based economy. Big businesses cannot survive in today's world without broadband, line sharing at least has created awareness in medium to small scale businesses to opt for broadband to be used as a tool for the growth of their businesses.

There is no credible data available to prove the fact that the recent surge in broadband growth rate is a proof of the fact that more and more small businesses are shifting to broadband while more and more residential users are opting for dial up connection for the only reason that it is affordable.

The momentum gained by the broadband proliferation needs to be egged on to gather critical mass to reap its full benefits for the society. It needs to be provided with the last push to gather that momentum which helps broadband to gather critical mass. From there onwards it will keep proliferating on its own.

It is evident from the previous discussion that household broadband use is fueled by the content available on the internet. When the content available can be accessed through dial up internet there is no incentive for the home user to pay additional charges on monthly basis and not getting the value of his/her money.

Present policy on broadband stops transportation of voice over the broadband. This barrier alone stops data operators from bundling services together to form an interesting boutique to seduce the customers to opt for higher speeds and thus subscribe to broadband over dial up connection.

Broadband and deregulation policies need adjustments to meet needs of the day.

E. Pricing model

In pricing wholesale bitstream access, there are two approaches i.e. Long Run Incremental Cost (LRIC) or Retail Minus. LRIC represents the incremental costs that an imaginary "efficient operator" would incur in providing services over the long run. For Retail Minus, the wholesale price is determined by deducting the wholesale service provider's retail price for a given service with a discount factor.

LRIC method is preferred. However, LRIC will require detailed cost accounting by incumbent and will take time to implement. It will be difficult to implement in the short run. Retail minus is easier to implement for bitstream access as there are already

existing retail prices offered by incumbent for reference. PTA prefers retail minus pricing method in the interim and switch to a LRIC method when it is ready. This interim period should not be more than 2 years.

In general, for retail minus pricing, the wholesale price is determined by deducting a discount factor (in percentage terms) from the retail price. This discount factor is usually tied to the retail cost of providing this product, which includes billing, marketing, distribution, customer support and other retail cost such as rental.

Wholesale price = Retail price – Discount Factor

If the retail cost for incumbent's ADSL products are available, the PTA should base the discount factor on the actual retail cost. In the absence of clear retail cost accounting by incumbent, we can benchmark against the countries that have used the retail minus method for wholesale bitstream access.

- New Zealand – discount factor ~25% of the retail price
- Ireland – discount factor of 24% to 30% of the retail price depending on the product

PTA proposes a discount factor of 25% if actual retail cost of incumbent is not available.

F. Geographical region and market segment considerations

In considering unbundling, it is possible to have different policies based on geographical regions and market segments (residential versus business). For example, in Canada's 1997 decision to impose unbundling, local loops in rural areas were treated differently to those in urban areas. The key rationale for this differentiation is to impose regulations only in areas where free competition does not work. In urban areas and the business market segment, there is usually free competition without intervention by the regulator. In rural areas where the cost of network rollout is much higher, the regulator can impose more stringent unbundling obligations to force the incumbent of open up its network.

G. Bitstream access

Since bitstream access is closely tied to interconnection PTA prefers that incumbent include it as part of the overall RIO**.** This will subject bitstream access to the same framework as other interconnection services for key regulatory areas:

- Pricing
- Roles and responsibilities of operators
- Provisioning
- Quality of Services

This will make it easier for the PTA to regulate bitstream access and it is also in line with international best practices.

Do you agree with the:

a. Key issues recognized to be addressed

b. Unbundling Options recognized

c. Analysis of the Options

d. Conclusion that Deregulation and Broadband Polices need adjustment to take the technological changes into account

VII. Implications for Recommendation

A. Implications on incumbent

1. Response to RUO request

Since liberalization of fixed line sector in 2004, incumbent has responded with a Reference Interconnect Offer (RIO) 2005. This RIO focuses on interconnection at bitstream access level only, including the following details:

1 Overall technical architecture and interface requirements for interconnection

2 Service provisioning workflow

3 Locations where bitstream access will be available

4 Locations of Point of Interconnections

5 Customer Premises Equipments (CPE) specifications

6 ATM interface specifications

The pricing for services is still underdevelopment.

Obligation on the incumbent to provide bitstream access to new licensees with a sunset clause would not impact incumbent's work on the current RUO.

2. Rollout of bitstream access

Since liberalization of fixed line sector in 2004, incumbent has already covered the three most important areas for providing bitstream access to new entrants:

- Technical specifications
- Service provisioning
- Pricing

Incumbent should be able to provide bitstream access to existing ISPs/Data operators by 2009, thus extending the service to new licensees should not pose any problems.

3. Changes in RIO

PTA proposes that incumbent include bitstream access in the RIO. This should have minimal impact on incumbent in view of services already extended to new entrants.

4. Accounts Separation

For proper pricing of wholesale bitstream access using either the LRIC method in the long run or retail minus in the short run, there is a need for incumbent to introduce account separation. In particular, the retail cost of providing ADSL should be separated from other costs.

Account separation for bitstream access should be in line with the recommendations the Interconnection paper which recommend LRIC pricing.

5. Service provisioning Response time

In the present arrangement implemented by incumbent, the response time for bitstream service provisioning are:

Response time for incumbent bitstream service provisioning

Acknowledge receipt of request	5 business days
Acceptance/rejection of request	10 business days
Design review by technical committee	10 business days for requests that involve only Network Conditioning in incumbent's network 20 business days for requests that involve work in addition to or as alternative to Network Conditioning in incumbent's network
Requirements, implementation charges and timetable for the use of bitstream service	Negotiated between incumbent and requesting party
Delivery lead time for incumbent	2 weeks for 100-blocks of ADSL ports in areas where capacity is available 24 weeks for 100-blocks of ADSL ports in areas where capacity is unavailable

Source: incumbent RIO

These response time proposed are comprehensive and reasonable. We recommend that future bitstream access offers include the same set of response time.

B. Implications for PTA

1. Amendments to RIO

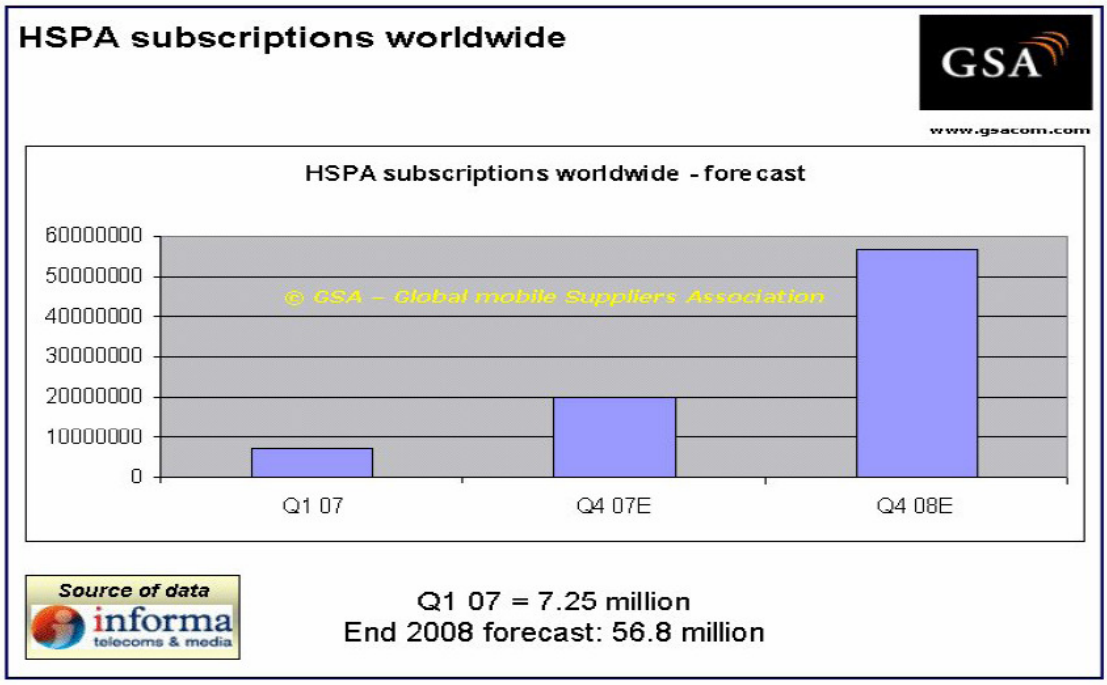
Adjustments will need to be incorporated to regulate unbundling

VIII. Conclusions

The Future of Mobile Broadband

According to GSA, the Global Mobile Suppliers Association, the number of commercial HSDPA networks launched worldwide grew by 80% in 2007 and to date commercial products are available in 26 of the 27 Member states of the EU. They also report that the rise of 3.5G is driving mobile broadband globally, with operators reporting strong subscription growth and increased profitability. According to Jupiter Research most new 3G phones will be HSPA-enabled and with the launch of HSUPA, customers will be enabled to upload content from their handsets to mobile networks, something that will become increasingly important with the growing adoption of user-generated content and the rise of social mobile networking. 53 Many operators are looking to future network development, and in the short term a number of markets will experience fairly healthy growth in both HSDPA and HSUPA. The chart below provides a forecast for global HSPA subscriptions between quarter 4 2007 and quarter 4 2008.

GSA - Forecasted HSPA Subscriptions Growth Worldwide Q408E



However, the technology is ever changing and 2008 will see the evolution of HSPA to HSPA Plus, which promises speeds of up to 28 Mbps. From there the next step on the evolutionary path is 3G Long-Term Evolution (LTE) and mobile WiMAX. Spectrum

largely dictates which technology is used but it would appear that these two technologies may be right for convergence. LTE may be able to match the capability of current DSL services but will not be widely deployed before 2009. However, while many enthuse about the potential of mobile broadband, issues remain as to whether mobile broadband can oust its fixed counterpart. Ovum suggest that it will take time for mobile speeds to reach fixed equivalents and that the slow deployment of HSUPA could also prove a barrier.54 Secondly, with the threat of financial penalties for exceeding the monthly cap, consumers may receive unexpectedly large bills.

There are many advocates who promote the idea that mobile broadband will represent a significant challenge to fixed-line internet service providers with the mobility and improved speeds 3G has to offer. Others debate this and feel that mobile broadband has a long way to go before it can potentially replace home-based alternatives, particularly for heavy users using the internet to download films and music. Research company Global Insight suggests that with the challenges facing mobile broadband, it will not displace fixed broadband but rather will 'probably continue to be marketed as a complementary service for a long time'. In the same report they suggest that Europe's broadband future in the near term lies in fixed broadband while mobile broadband may grab up to 5% of the the market in the next five years.

1. Unbundling (line sharing) already in place since year 2000, has brought taste of broadband, however failed in generating real competition

2. Present broadband market in Pakistan can be equated with mobile market before issuance of two additional mobile licenses

3. Competition needs to be generated through all possible means

4. Bundling of services has generated healthy competition and brought effective cost of broadband radically down in other countries

5. Household is the major catalyst in the spread of broadband, around the globe

6. Broadband policy revolves around e-commerce and e-governance alone, leaving the home user out of the loop

7. Internet with its long history could not transform Pakistan into a broadband society mainly due to:

    a. No possibility of value addition for home user

    b. Affordability

    c. Broadband policy

8. UNE, with associated implementation difficulties, was tried in North America and failed miserably. No other country tried the concept.

9. Bitstream Access was not mandated by most of the developed countries and left it to the market players to enter into contracts or otherwise.

10. Wholesale concept started off well at the start of unbundling, however, pattered out when the competition gained critical mass.

11. Sub Loop Unbundling is still in the product development stage and it is very early for Pakistan to opt for such unbundling at this stage; it may scare away investment in optical fibre access network.

12. Wireless solutions i.e. outdoor Wi Fi hotspots, WiMAX (mobile as well as fixed) appears a viable solution for its comparative ease to "roll out" coupled with "time to market", however, cost of the CPE is a major bottleneck. Efforts should be made to bring the cost of CPE down without any subsidies.

13. Cable Modem is the second major access technology although on the retreat; it still has great potential for our market.

14. DSL, presently, is the major underlying technology for broadband access, although on the decline in few countries of the world; it is the most viable solution at this point in time.

15. FTTx, though at the third place in terms of number of connection globally, has great potential to catch up with DSL- Cost of CPE coupled with roll out problems (right of way) has two major bottleneck for the time being.

16. Introduction of 3G in the local mobile market may further help proliferate broadband penetration, more specifically, in the business sector.

Recommendations

PTA concludes that full local loop unbundling is best option for broadband proliferation. However, to achieve positive results for this option it is important that retail unit is separated from the incumbent on the lines "Openreach" was created from BT.

In the interim, Wholesale Bitstream Access to introduce competition at the retail level quickly without incurring too much cost, coupled with wholesale bitstream with a sunset clause is the unbundling option that is most suitable. The sunset clause would be tied to the network rollout obligations of the new licensees. PTA can then review the need to extend the clause before the termination date of the sunset clause.

The pricing methodology for "copper" for full unbundling and bitstream access would be based on the LRIC model in line with other interconnection services. However, PTA recognizes that LRIC will take time to implement and therefore recommend a Retail Minus pricing method in the interim.

There is no need to differentiate unbundling policies based on geographical regions or business segments as there is no difference in the status of competition. Since bitstream access is closely tied to other interconnection service, PTA prefers that it be included in the RIO. This is in line with international best practice and also simplifies PTA's regulations.

To translate bulk of 3.5million internet into broadband (78033-DSL) access through mandating following during deregulation policy review due this year:

a. Full local loop unbundling

b. Independent retail company for local loop

c. Mandating Wholesale

d. Value addition to Broadband for the service providers to offer attractive bundled services for household

Do you agree with

A. Conclusions drawn

B. *Recommendations*

IX. Glossary of Terms

Access network: Electronic Communications Network which connects end-users to a service provider; running from the end-user's premise to a Local Access Node and supporting the provision of access based services. It is sometimes referred to as the local loop or last mile.

ADSL: (Asymmetric Digital Subscriber Line): A digital technology that allows the use of a standard telephone line to provide high speed data communications. Allows higher speeds in one direction (towards the customer) than the other

ADSL1: The first generation of ADSL, capable of data speeds of up to 8Mbit/s towards them customer and up to 640kbit/s from the customer

ADSL2/ADSL2+: Improved versions of ADSL, offering high speeds, especially on shorter telephone lines. In the case of ADSL2+, up to 24Mb/s can be delivered towards the customer.

Bit-rate: The rate at which digital information is carried within a specified communication channel.

Bitstream: A wholesale service providing conveyance of data traffic from an end user's premise to a point of interconnection made available by the incumbent to a competitive provider.

Bluetooth: Wireless standard for short-range radio communications between a variety of devices such as PCs, headsets, printers, mobile phones, and PDA.

Broadband: A service or connection generally defined as being 'always on' and providing a bandwidth greater than narrowband.

CDMA: Code Division Multiple Access, the basis for the primary 2G technology; and the later evolution of mobile technology in the US and related markets. A technology that allows a band of spectrum to be shared by multiple concurrent users, rather than subdividing the spectrum (FDMA) or determining use on a round robin basis (TDMA), unique codes are used to differentiate subscribers so they can simultaneously use the same spectrum.
Contention ratio: An indication of the number of customers who share the capacity available in an ISP's broadband network. (Figures of 50:1 for residential broadband connections and 20:1 for business are typical).

Co-regulation: The sharing of regulation between a statutory body (e.g. Ofcom) and its
licensees.

CPS: Carrier Pre-selection. The facility offered to customers which allows them to opt for certain defined classes of call to be carried by an operator that has been selected in advance and has a contract with the customer. CPS does not require the customer to dial a routing prefix or use a dialer box.

DAB: Digital Audio Broadcasting. A set of internationally accepted standards for the technology by which terrestrial Digital Radio multiplex services are broadcast in the UK

Data packet: In networking, the smallest unit of information transmitted as a discrete entity from one node on the network to another.

Digital dividend: The spectrum that will be released by the switch to all-digital television.

Digital switchover: The process of switching over the current analogue television broadcasting system to digital, as well as ensuring that people have adapted or upgraded their televisions and recording equipment to receive digital TV.

DMB: Digital Mobile Broadcasting. A variant of the DAB digital radio standard for mobile TV services, and an alternative to DVB-H (see DVB, below)

Downlink speed: Also downlink or download. Rate of data transmission from a network operator's access node to a customer, typically measured in Megabits per second

DSL: Digital Subscriber Line. A family of technologies generally referred to as DSL, or xDSL, capable of transforming ordinary phone lines (also known as 'twisted copper pairs') into high speed digital lines, capable of supporting advanced services such as fast Internet access and video-on-demand.
ADSL, HDSL (High data rate Digital Subscriber Line) and VDSL
(Very high data rate Digital Subscriber Line) are all variants of xDSL).

DVB: Digital Video Broadcasting. A set of internationally accepted open standards for digital broadcasting, including standards for distribution by satellite, cable, radio and handheld devices (the latter known as DVB-H)

Ex ante regulation: Regulation to address behavior before it happens.

Fibre-to-the-cabinet Access network consisting of optical fibre extending from the access node to the street cabinet; the street cabinet is usually located only a few hundred meters from the subscriber premises. The remaining segment of the access network from the cabinet to the customer is usually a copper pair but could use another technology, such as wireless.

Fibre-to-the-home: A form of fibre optic communication delivery in which the optical signal reaches the end user's living or office space.

Fibre-to-the-building: A form of fibre-optic communication delivery in which an optical fibre is run directly onto the customers' premises.

GSM: Global Standard for Mobile Telephony, the standard used for 2G mobile systems.

HD Radio: Hybrid Digital Radio. A radio standard developed in the US for terrestrial broadcasters, offering high-quality audio.

HDTV: High-Definition Television. A technology that provides viewers with better quality, high-resolution pictures

Headline connection speed: The theoretical maximum data speed that can be achieved by
a given broadband. A number of factors, such as the quality and length of the physical line from the exchange to the customer, mean that a given customer may not experience this headline speed in practice.

HSDPA: High Speed Data-link Packet Access, an evolution of 3G mobile technology, often known as 3.5G, which offers higher data speeds.

HSUPA: High Speed Uplink Packet Access – an upgrade to 3G mobile technology that allows data to be sent from customer's devices more quickly.

Interconnection: The linking of one Public Electronic Communications Network to another for the purpose of enabling the persons using one of them to be able (a) to communicate with users of the other one; (b) to make use of services provided by means of the other one (whether by the provider of that network or by another person).

International roaming: A service offered by mobile operators that allows customers to use their phone abroad. The home operator has agreements with foreign operators that allow customers to make and receive calls, send and pick up text messages, and use some of the other mobile services (such as access to voicemail or topping-up credit on pre-pay phones). The exact services available and the charges for their use vary between operators.

Internet: A global network of networks, using a common set of standards (e.g. the Internet Protocol), accessed by users with a computer via a service provider.

IP (Internet Protocol): The packet data protocol used for routing and carriage of messages across the Internet and similar networks.

IPTV Internet Protocol Television: Television and/or video signals that are delivered to subscribers or viewers using Internet Protocol (IP), the technology that is also used to access the Internet. We use the term to mean delivery over a 'closed intranet', typically operated by ISPs and local-loop unbundlers, rather than over the public internet. IPTV services are hosted on servers placed in the exchange, which means

they can be delivered with assured QoS since the ISP has more control over the network.

ISDN Integrated Services Digital Networks: A standard developed to cover a range of voice, data, and image services intended to provide end-to-end, simultaneous handling of voice and data on a single link and network.

ISP Internet Service Provider: A company that provides access to the internet.

LLU (Local Loop Unbundling): LLU is the process whereby incumbent operators (in the UK this means BT and Kingston Communications) make their local network (the lines that run from customer's premises to the telephone exchange) available to other communications providers. The process requires the competitor to deploy its own equipment in the incumbent's local exchange and to establish a backhaul connection between this equipment and its core network.

Local Loop: The access network connection between the customer's premises and the local PSTN exchange, usually a loop comprised of two copper wires.

Multichannel: In the UK, this refers to the provision or receipt of television services other than the main five channels (BBC ONE & TWO, ITV1, Channel 4/S4C, Five) plus local analogue services. 'Multichannel homes' comprise all those with digital terrestrial TV, satellite TV, digital cable or analogue cable, or TV over broadband. Also used as a noun to refer to a channel only available on digital platforms (or analogue cable).

Multiplex: A device that sends multiple signals or streams of information on a carrier at the same time in the form of a single, complex signal. The separate signals are then recovered at the receiving end.

Narrowband: A service or connection providing data speeds up to 128kbit/s, such as via an analogue telephone line, or via ISDN.

Next-generation core networks (NGN): Internet Protocol based core networks which can support a variety of existing and new services, typically replacing multiple, single service legacy networks

Next-generation access networks (NGA): Broadband access networks that connect the end-user to the core network capable of a bandwidth quantity and quality significantly in excess of current levels (a benchmark of 20Mbit/s or more is often used).

OECD: Organization for Economic Cooperation and Development.

Oftel: Office of Telecommunications, whose functions transferred to Ofcom on 29th December 2003.

Peaktime: In the UK, the period during which: a radio station broadcasts its breakfast show and, on weekdays only, also its afternoon drive-time show; a television station broadcasts its early- and mid-evening schedule. Typically used by Ofcom to refer to the period between 18:00 and 22:30 each day (including weekends).

Peer to peer distribution: The process of directly transferring information, services or products between users or devices that operate on the same hierarchical level.

PSTN: Public Switched Telephony Network.

Quad-play: Supply of TV, broadband, landline and mobile from a single supplier for a single subscription fee.

Regulatory holiday: A commitment by a regulator not to impose regulatory measures on a given product or service for a specified period of time.

Service bundling (or multi-play): A marketing term describing the packaging together of different communications services by organisations that traditionally only offered one or two of those services.

Service provider: A provider of electronic communications services to third parties whether over its own network or otherwise.

SIM card (Subscriber Identity Module): A removable smart card used in mobile phones to authenticate the mobile subscriber and store data. Each card has a unique number known as International Mobile Subscriber Identity (IMSI).

Simulcasting: The broadcasting of a television or radio programme service on more than one transmission technology (e.g. FM and MW, DAB and FM, analogue and digital terrestrial television, digital terrestrial and satellite)

Streaming content: Audio or video files sent in compressed form over the internet and consumed by the user as they arrive. Streaming is different to downloading, where content is saved on the user's hard disk before the user accesses it.

Sub-loop unbundling: A variant of LLU where a competitive operator takes control of only a portion of a customer's local loop, allowing them to install their equipment closer to the customer and potentially offer higher-speed services. In Sub-loop unbundling, the point of handover is commonly the Primary Connection Point (PCP) or street cabinet.

Triple-play: Supply of TV, broadband and landline from a single supplier for a single subscription fee.

VDSL: Very high bit rate DSL. This is currently the fastest version of DSL and can transmit very high data rates on short reaches of the local loop.

VoD: Video on Demand A service or technology that enables TV viewers to watch programs or films whenever they choose to, not restricted by a linear schedule. Also Near Video on Demand (NVoD), a service based on a linear schedule that is regularly repeated on multiple channels, usually at 15-minute intervals, so that viewers are never more than 15 minutes away from the start of the next transmission.

VoIP: Voice over Internet Protocol. A technology that allows users to send calls using Internet Protocol, using either the public Internet or private IP networks.

WCDMA: Wideband Code Division Multiple Access. One of the family of 3G mobile technology standards.

Web 2.0: A perceived second generation of web-based communities and hosted services - such as social-networking sites and wikis, which facilitate collaboration and sharing between users

WiFi hotspot: A public location which provides access to the internet using WiFi technology.

WiMAX: A wireless MAN (metropolitan area network) technology, based on the 802.16 standard. Available for both fixed and mobile data applications

Wireless LAN or WiFi (Wireless Fidelity): Short range wireless technologies using any type of 802.11 standard such as 802.11b or 802.11a. These technologies allow an over-the-air connection between a wireless client and a base station, or between two wireless clients.

WLR: Wholesale Line Rental A regulatory instrument requiring the operator of local access lines to make this service available to competing providers at a wholesale price.