Chapter 1: Business Strategies

Telecoms operators are now employing new strategies to deliver thrilling new services using next generation networks. The full package of services includes line rental and fixed line telephony with a combination of Internet access, IP television, video on demand (VoD), entertainment applications and, eventually, cellular phones. Using the terms adopted by the industry, we are talking about *Triple Play* and *network convergence*. In other words this means: multiple services, multiple devices, but one network, one vendor and one bill (see Figure 1-1).

This manoeuvre is much more than just a new commercial product. It is a consequence of the important changes the industry is undergoing, such as technological innovations, social changes and new regulations. These changes have persuaded operators to redefine their businesses based around a new unified network that should be able to support any type of telecoms service.

Beyond each particular strategy we can identify some of the common drivers, such as a declining voice business (see Figure 1-2), the flat profit perspectives on data access, the new regulations encouraging competition, and the technological achievements that have made network convergence possible.

Triple Play: Building the Converged Network for IP, VoIP and IPTV Francisco J. Hens and José M. Caballero

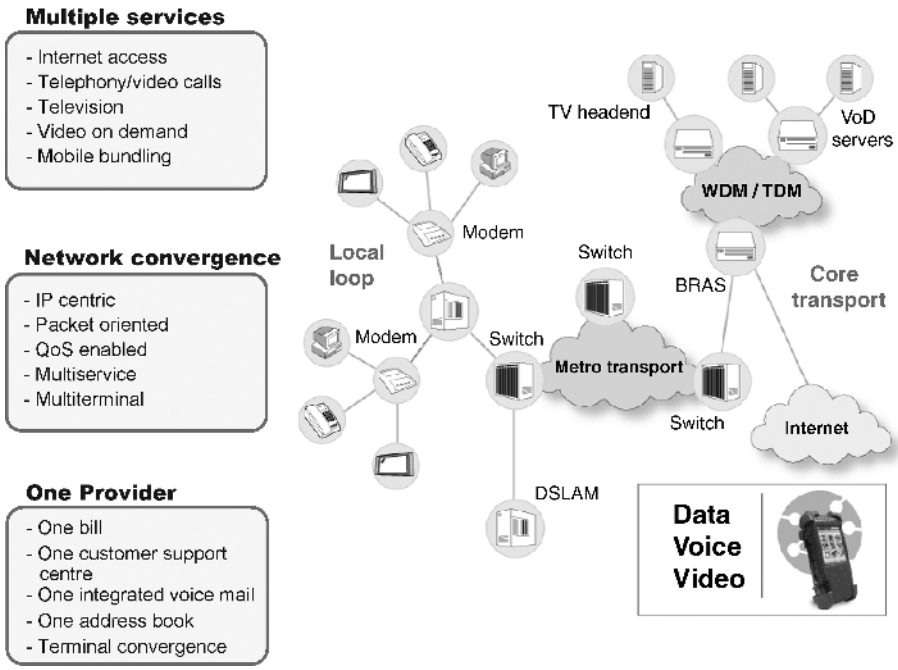

Figure 1-1. Triple Play aims to unify telecommunication services by using a single network to deliver a bundle of multiple applications.

1.1 Expanding Telco Businesses

Voice is still a profitable business with margins of over 50%; however, in the case of traditional fixed telephony, this is rapidly declining (see Figure 1-3). In many cases the fixed phone service is included in the same flat bill with the Internet access and line rental. On the other hand, the growth rate of the cellular telephony business is now less than it was a few

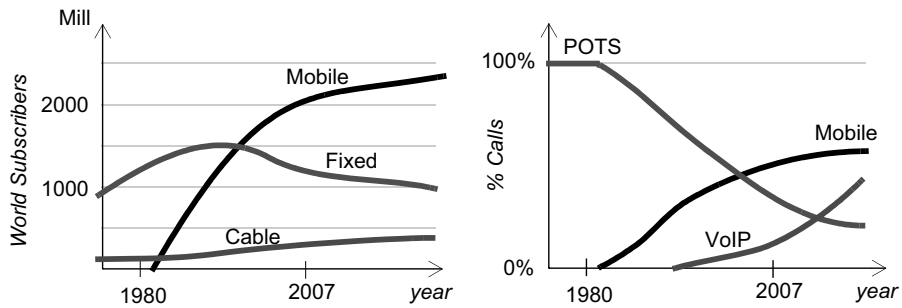

Figure 1-2. Mobile and cable subscribers undermine up to 2% of fixed line subscribers per year. Reproduced by permission of Trend Communications Ltd.

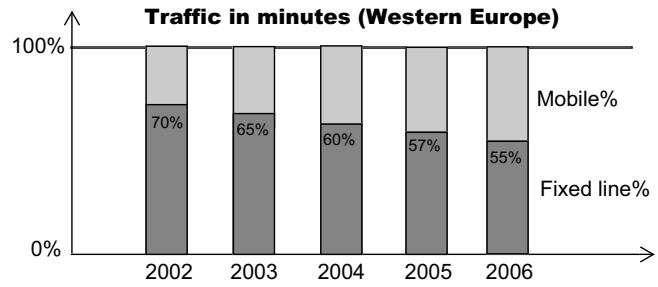

Figure 1-3. Voice revenues based on fixed lines are declining and wireless voice revenues are not growing as in the previous decades. Reproduced by permission of CMT.

years ago and is nearly at saturation point in developed countries. Unfortunately for fixed line operators, alternative services such as broadband access have become a commodity difficult to differentiate, making it impossible to compensate for declining voice revenues.

After several failed attempts the telecoms industry has apparently found a remedy for its continuous headache of offering multiple services as a commercial package that includes fixed line rental and wireless services all in one monthly bill (see Figure 1-4). These multiple services are often referred to as Triple Play. It is too early to know if this is going to be the solution for the telecom crisis that started in 2000 with the 3G licences and the dot.com bubble, or is it just 'another case of mass hysteria in the telecoms industry'? (*The Economist*, 12 October, 2006).

Bundling video with existing data and voice services goes further than a pure marketing campaign; it is essential to keeping telcos in the residential business. It is, in fact, a very

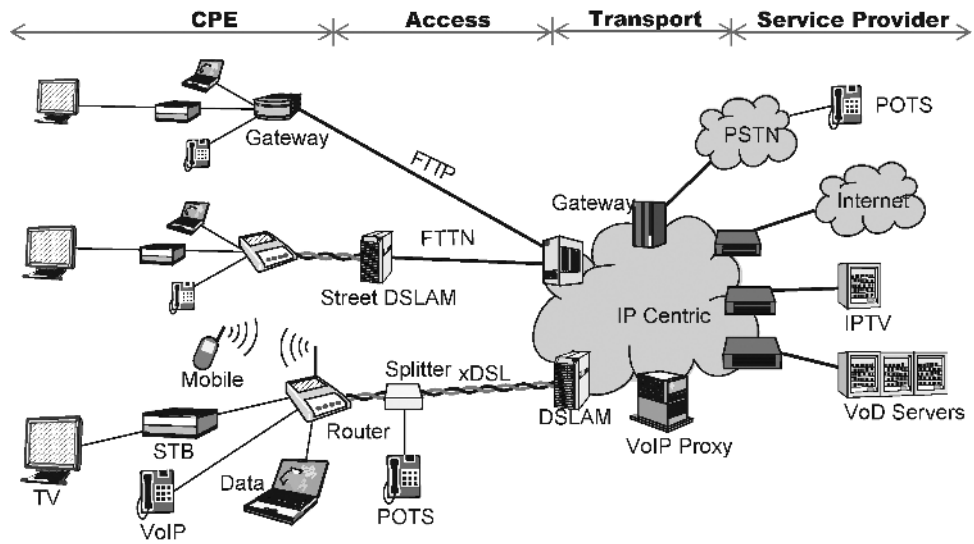

Figure 1-4. Multiple services mean one network, various terminals and many types of access.

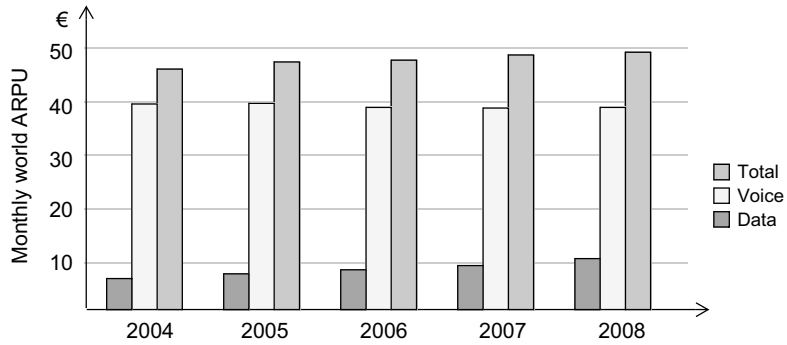

Figure 1-5. Evolution of world ARPU. Reproduced by permission of Telegeography Research.

ambitious strategy with well-defined targets:

- *Reduce churn* – gain customer loyalty with one package that includes all services supplied by one vendor.
- *Minimize costs* – integrate infrastructures and human teams using network convergence.
- *Gain TV customers* – telecom operators should use the same weapons as the cable companies to supply television services.
- *Increase profits* – by using legacy and innovative applications to raise the average revenue per user (ARPU) (see Figure 1-5).
- *Grow the brand name* – cultivate the perception of the company as being able to supply any type of telecommunication service.
- *Improve service provision* – use advanced management solutions for quick and easy provisioning.
- *Network convergence* – incorporate new technologies and recycle existing network infrastructures.

Triple Play is focused on a combined service rather than on the development of new applications, protocols or architectures (see Figure 1-8). We have already explained this is as a marketing concept concerning Internet access, television and phone services. All of them are provided by one vendor, delivered over a single access network and paid with one bill. To offer Triple Play requires a technologically enabled network that can transport all the three basic communication flows (audio, video, data) through the same pipe. In essence Triple Play is not really a new service, but a concept related to a new business strategy on two planes:

1. *Commercial bundle*, the concept referred to as a package of services.
2. *Technological convergence*, the concept referred to as an IP centric network, enriched with the facilities to support and deliver all the services.

Triple Play is appealing to customers because it simplifies the subscription and support of several telecoms applications. The problem for providers is that price, quality

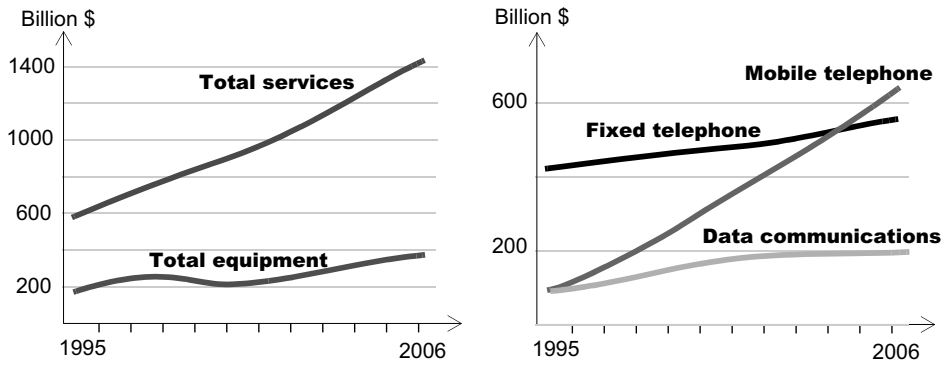

Figure 1-6. Telecom world market revenues in services and equipment. Reproduced by permission of International Telecommunications Union.

and contents are very important, especially as most services are not new at all, except in the format and the interfaces that are used to supply them. Efforts to reduce customer bills would also reduce total market revenues, therefore development of new applications is essential for the business (see Figure 1-6).

1.2 Triple Play Applications

A large number of applications can be designed and supplied over a converged network (see Figure 1-7). Triple Play applications are often a combination of several types of such as data, audio and video, that are managed by a number of parameters such as bandwidth, source/destination relationship, type of routing, QoS and traffic symmetry (see Table 1-1).

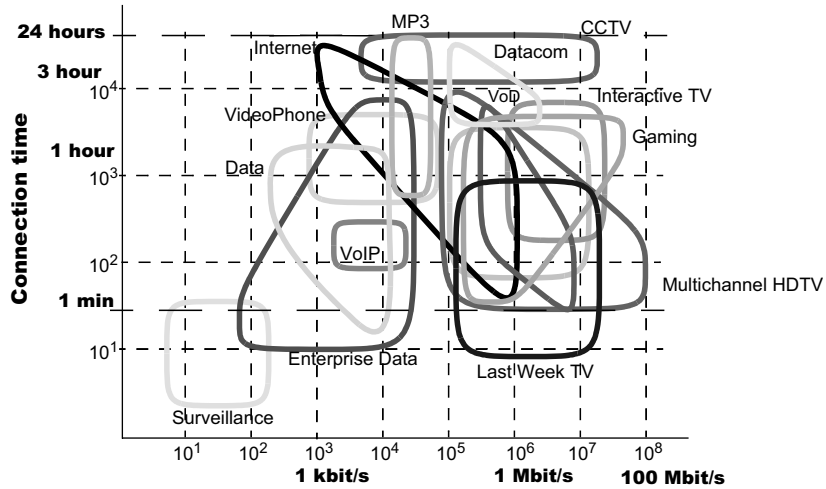

Figure 1-7. Triple Play applications: bandwidth and time requirements.

Table 1-1. Triple Play applications

Application	Pld[a]	Rel[b]	QoS[c]	Sym[d]	Comments
IPTV channels	A, V, D	P2M	P	A	Free of charge
HDTV	A, V, D	P2M	P	A	High definition IPTV
Pay per view TV	A, V, D	P2M	P	A	Pay per view
VoD on STB	D	P2P	B	A	Downloaded to the STB before visualization
VoD on network	A, V, D	P2P	P	A	Requires a network server
Channel search	D	P2P	B	A	On: theme, actor, language...
Pseudo VoD	A, V, D	P2M	P	A	*N* delayed channels/program
Video conference	A, V, D	M2M	G	B	Multiparty conference with image
Voice over IP	A, D	P2P	G	S	Inc. data services that is, presence
Broadcast radio	A, D	P2M	P	A	Using TV transport stream
Streaming radio	A	P2M	P	A	Using Internet
Voice mail	D		P	A	Non-real-time voice messages
Hi Fi audio	A	P2P	P	A	Pay per listening session
Audio downloading	A	P2P	B	A	For MP3 players
Gaming individual	D	P2P	G	A	Individual or group
Gaming group	D	M2M	G	S	Pay per play
Fax	D	P2P	B	A	Fixed to VoIP
e-Commerce	D	M2P	B	A	Web sales applications
VPN services	D	M2M	P	S	Business application
Hi-Speed Internet	D	P2P	B	A	Entertainment, home working
Storage services	D	P2P	G	A	Business application
Surveillance	D	P2P	B	A	Alarms
Home automation	D	P2M	B	A	Remote control, monitoring
Instant messaging (IM)	D	P2M	B	B	Real-time short messages
e-mail	D	P2M	B	U	Non-real-time messaging
www	D	P2P	B	A	Information browsing based on hypertext
File transfer	D	P2P	B	A	Data download and upload from/to a server
UMA	A, V, D	P2P	G	S	Unlicensed mobile access
Mobile convergence	A	P2P	G	S	Call redirection to fixed line
SMS	D	P2P	B	U	Non-real-time wireless short messages

[a] *Payload*: audio, video, data (A/V/D).
[b] *Relation*: point to point, point to multipoint, multipoint to point, multipoint to multipoint (P2P/P2M/M2P/M2M).
[c] *QoS*: best effort, prioritize, guarantee (B/P/G).
[d] *Traffic symmetry*: unidirectional, bidirectional, asymmetric (U/B/A).

1.2.1 Television and Video Services

Television services can be implemented following several models by taking into consideration parameters such as resolution, coding and the service model. Nevertheless, it is the transmission mode, broadcast or multicast what modifies the service:

- *Broadcast channels* – channels are broadcast/multiplexed simultaneously in TDM or FDM over the transmission media. Subscribers use the tuner on the TV box to select which one to display. This model is used by cable, terrestrial and satellite broadcasters.
- *Unicast/multicast channels* – channels are streamed independently to reach the customer premises that have selected the stream previously. This is the model selected by telcos, in principal, because of the lack of bandwidth at the first mile.

Figure 1-8. Residential customers are focused on applications such as IPTV, VoD, video recording, telephony, Internet access, gaming, hi-fi audio, home automation and mobile bundling. Business customers are focused on connectivity applications such as VPN, broadband access, corporate VoIP and mobile convergence.

Digital video provides a set of interesting possibilities such as metalanguage programmes (one video, several audio signals), customized adverts, pay-per-view or encrypted programmes only for subscribers (see Fig. 1-8). Interaction between the subscribers and the service provider make new capabilities such as games, magazines, voting, competitions, pay-per-view, customized adverts and quizzes. At the end of the day interaction is the key difference between broadcast TV and bidirectional digital platforms.

1.2.1.1 Welcome to the Contents

For most telcos, the television and video business is new. Any previous experience of these services was no more than signals transported in SDH envelopes between the different centres of TV broadcasters, but now that Telcos are also service providers, it is necessary to manage not only the transport and signal distribution, but also the contents; a set of attractive programmes to compete with existing cable operators and broadcasters.

Therefore, telcos must not only acquire new technical and business skills to enter into this already mature market, but should also be involved in the creation of content that is adapted

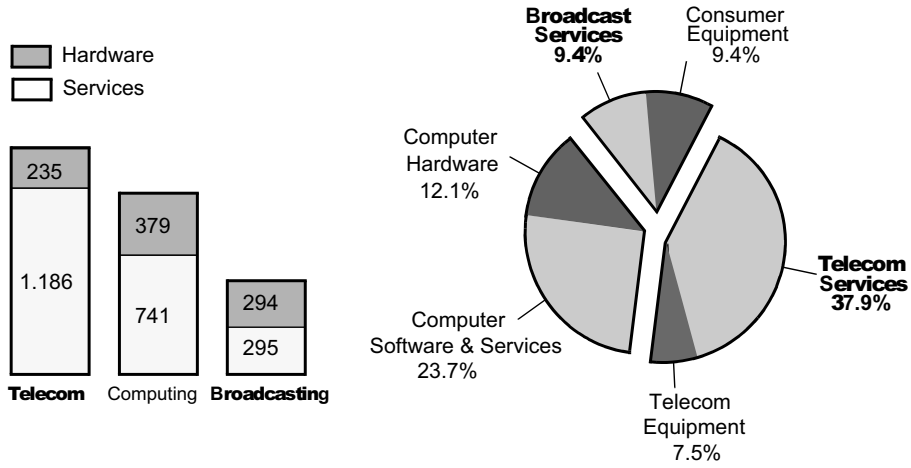

Figure 1-9. The global information and communication technologies market (ICT) indicates that the total broadcasting market is about the 40% of the telecom market; however if we consider only the services segment, the size is only 25%. Reproduced by permission of International Telecommunications Union.

to their specific consumer market. This explains why many telcos have created their own studios or signed contracts and joint ventures with content providers to gain access to suitable and appealing programmes, libraries of movies and specialized channels (see Figure 1-10).

1.2.2 Video on Demand

The video on demand (VoD) service is quite different from IPTV as it enables users to select and watch a video as part of an interactive system. VoD systems have two important features:

1. They enable users to choose the video they want to watch from a digital library selection. Users can control the moment they start watching the video.
2. They provide typical DVD functionality such as pause, fast forward and fast rewind.

For streaming systems this requires more bandwidth on the part of the server, powerful multicast nodes, spare bandwidth and guaranteed QoS control. VoD servers can operate in two ways: streaming or downloading the contents. In both cases this is a point-to-point relation (see Table 1-1). If downloading is being used only a 'best effort' QoS is necessary since the video is recorded onto a network disk, a PC, or a set top box before it is watched.

VoD is one of the killer applications that makes the Triple Play service more attractive when operating over a rich IP network, because cable and satellite operators have more difficulties in implementing this.

1.2.3 New TV Receivers

The migration from analogue and standard definition TV to digital and high definition TV (HDTV) started several years ago. Now mature markets already have many TV receivers enabled to receive digital signals. The new trends are incorporating high definition into new receivers and enabling interactivity in commercial TV applications.

1.2.3.1 Coding

The digital codification of a high-resolution TV program generates a 20 Mbit/s stream while standard resolution generates about 6 Mbit/s. This can be reduced significantly using compression algorithms such as Moving Pictures Experts Group (MPEG) or Windows Media (WM). Both can offer several alternatives depending on the resolution, and the compression level (see Table 1-2).

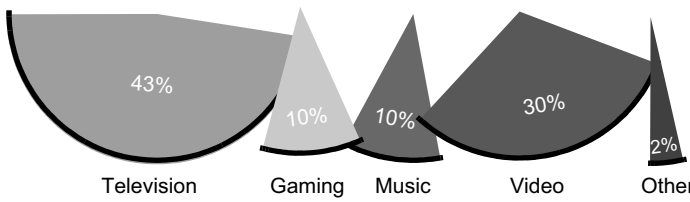

Figure 1-10. Watermelon distribution of the entertainment business. Reproduced by permission of Trend Communications.

Table 1-2. Standard and high-definition bandwidth after compression.

	Lines	Pixels	Broadcast	MPEG-2	MPEG-4	WM9
SDTV	480	704 × 480	6 Mbit/s	3.5 Mbit/s	2–3.2 Mbit/s	2–3.2 Mbit/s
HDTV	1080	1920 × 1080	19.2 Mbit/s	15 Mbit/s	7.5–13 Mbit/s	7.5–13 Mbit/s

The most popular compression family of standards is probably MPEG, defining algorithms based on the discrete cosine transform (DCT) that discards spatially redundant information, and employs movement compensation techniques to minimize temporal redundancy. MPEG-2 is very common, and MPEG-4 is a step-ahead standard that covers small mobile hand sets up to large HDTV receivers. Windows Media 9, a Microsoft development, is also an interesting alternative.

1.2.4 Voice over Internet Protocol

In many aspects Voice over Internet Protocol (VoIP) is also an approach to the Internet world using IP packets to carry the voice signals to incorporate features that would be difficult using traditional phone services. For example, VoIP may allows users to talk for as long they like, subscribers can always be on-line then other users may know about their presence. Depending on how the service has been implemented it is possible to send images, data and videos simultaneously to the people they are talking to. Another interesting aspect is how VoIP phones can use the e-mail address as an identifier and can make calls to an e-mail address as well. Moreover, the phone call list can be made up using a combination of PSTN numbers and e-mail addresses. Access of nomadic users is guaranteed in a similar way to Internet-based mailers, regardless of where in the world the connection to the Internet is established, thanks to proxy servers.

A commercial VoIP service should not be restricted to VoIP phones, but heterogeneous calls between VoIP and ISDN, POTS or GSM phones will be quite normal for a long time. It is not realistic to forecast a full substitution in the short or middle term.

1.2.4.1 Less Expensive Phone Service

The phone service based on VoIP generally costs less than the equivalent based on the traditional Public Switched Telephone Network (PSTN). This fact has been justified by saying that packet-oriented technologies are more efficient that circuit oriented ones because they permit the utilization of a single network to carry voice together with data and video. This hypothesis has been proved, at least according to the 2006 survey carried out by Consumer Reports in the US. The survey said that people who have purchased VoIP service are reportedly saving around $50 per month on their bills.

It is also important to bear in mind that incumbent operators already have a satisfactory quality phone service and in many cases it has already been bundled with ADSL and line rental. That means that the PSTN cost has been deflated and this can explain why legacy operators have little interest in rolling out a new VoIP service that would demand more resources for very low benefits (see Figure 1-12).

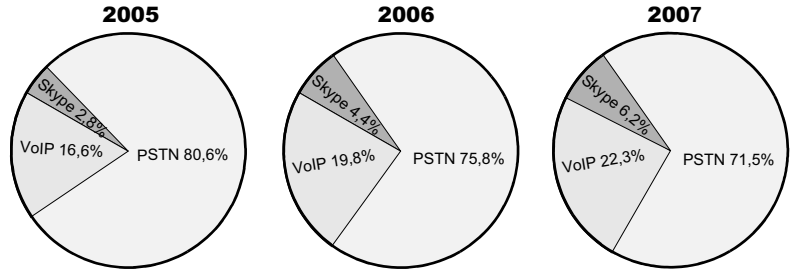

Figure 1-11. International traffic transport. Reproduced by permission of Primetrica and Trend Communications Ltd.

1.2.4.2 Drawbacks

The VoIP phone service relies on the Internet connection so consequently the service can be affected if the quality and bit rate are not appropriate, causing distortions, noise, echoes and unacceptable delays. Most of the drawbacks can be overcome by increasing the bandwidth, minimizing contention, and using more elaborated protocols to prioritize VoIP traffic while controlling delay and packet loss. It may also be worth considering modifying firewalls and adapting network address translation (NAT) tables used at the boundary routers.

1.2.5 VoIP Rollout

VoIP is a very important technological, financial and social change after a century dominated by national operators and a phone service based on circuits (see Figure 1-11).

However, the complete migration, or eventual substitution, will take many more years than *experts* first thought. At the end of the day the installed PSTN base is massive, quality is excellent and customer bills are continuously deflating (see Figure 1-12). Incumbent operators should manage VoIP as a complement whilst maintaining the existing POTS and ISDN services. It is significant that a decade after main manufacturers announced VoIP solutions, the traffic penetration still scores below 20% in developed countries, and this level is thanks to early users like youngsters, travellers, and low income users.

The challenge of VoIP rollout is not insignificant given the complexity of hybrid solutions that also combine traditional PSTN phone calls with the new packet-based

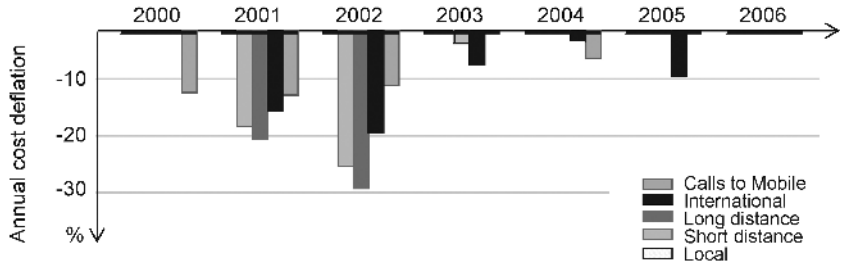

Figure 1-12. Annual deflation of phone calls originated on fixed lines. The Telefonica case. Reproduced by permission of Telefonica.

solution. Just imagine how many protocol translators, gateways and transcodecs that would be necessary to set up a multi-conference between VoIP, POTS and mobile to guarantee compatibility and interconnections.

1.3 Driving Factors of Triple Play

Two main groups of driving factors can be identified: firstly, the necessity to redefine the telecom business and, secondly, the consequence of competitive pressure.

1.3.1 Business Redefinition

Telcos' initial advantage in voice and data access was quickly blurred by new competition forcing them to operate to thin profit margins and even no profits at all. In order to change the shape of the business, telcos have discovered how a DSL broadband router can be combined with a converged network that allows the development of a set of new multimedia applications.

The strategy starts by offering bundled voice and Internet access paving the way for the introduction of television to existing subscribers. IPTV will never completely replace broadcast or cable TV, but will complement them and gain significant market share with an interactive platform built around the IP protocol. Video on demand, pay-per-view (PpV), and video recording services will also need to be more innovative to gain market share.

1.3.1.1 Telcos' Point of View

Above all, telcos feel that they have finally found, in Triple Play, a unique opportunity to redefine the whole business. This strategy requires a high capital expenditure (CAPEX) to develop a converged network, but will allow innovative product creation by combining legacy and new products and will also reduce operational expenses (OPEX) in an integrated management environment.

At the end of the day telcos expect to increase revenues by means of the new services while keeping existing subscribers loyal to the old ones.

1.3.1.2 Consumers Point of View

There is much evidence to suggest that customers are willing to buy a telecom service package, whenever they can get significant savings on their bill for the full service. Customers would also like to reduce the increasing level of complexity in managing their technological devices. Just how many devices, remote controls, configurations and interconnections can there be in modern homes equipped with PCs, satellite, Hi/Fi, digital TV, mobiles, video, gaming stations and surveillance devices? Residential customers are demanding simple, easy-to-use integrated technological devices that offer more automatic features.

1.3.2 Competitive Pressure

Just a few years ago, companies such as cable operators, ISPs and telcos were different businesses and were not competing with each other. Cable operators were focused on video

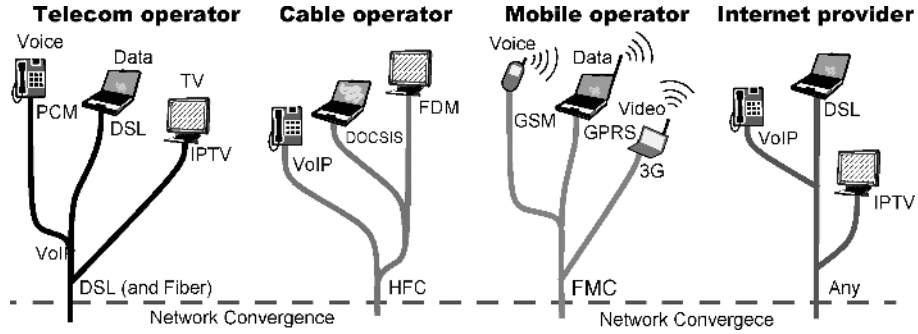

Figure 1-13. Each operator has their own migration strategy for network convergence.

and TV services, ISPs did not go much further than offering IP data services while the main business of telcos was based on voice and datacom services such as T1, E1, FR or DSL.

The advance in technology and new regulations have made ISPs, cable and mobile operators competitors of telcos in voice and data access. So companies that were originally in different markets are all now racing to bundle and offer the same services:

- *Mobile operators*, that are offering wireless technologies have produced a significant social change. Now telephony is a personal service that combines privacy with mobility. It is not a secret that wireless has stolen an important part of fixed line revenues, moreover wireless-only operators are constantly suggesting that all telecom services can be delivered using only wireless technologies. Mobile operators, that have invested in 3G infrastructures, are very keen to bring new applications based on voice, Internet, video and messaging into service. However, it is not very clear what the volume of new revenues will be as multimedia service expectations are not very optimistic (see Figure 1-13).
- *Cable operators*. New regulations have allowed cable operators to grab the traditional telcos market. Cable operators, that started out offering just TV, were the first to offer Triple Play thanks to the Data Over Cable Service Interface Specification (DOCSIS). This technology enabled them to also deliver broadband Internet access to their subscribers which later on opened the door to include VoIP as well (see Figure 1-13).
- *Internet service providers*. ISPs probably are the most important threat to the traditional phone service as inexpensive voice calls can potentially reduce voice revenues to a minimum. ISPs are experts on IP services and do not have to manage large infrastructure assets. This fact has enabled them to build a flexible and innovative model around the Internet. VoIP solutions based on software such as Skype are an excellent example of how ISPs are exploiting this opportunity (see Figure 1-13).

The result is that companies, originally in different markets, are now all racing to bundle multiple services using their own version of a converged network (see Table 1-3). The consequence is that fixed telephony use and revenues are declining after the adoption of mobiles and the penetration of cable operators that also include broadband access and voice services (see Figure 1-14).

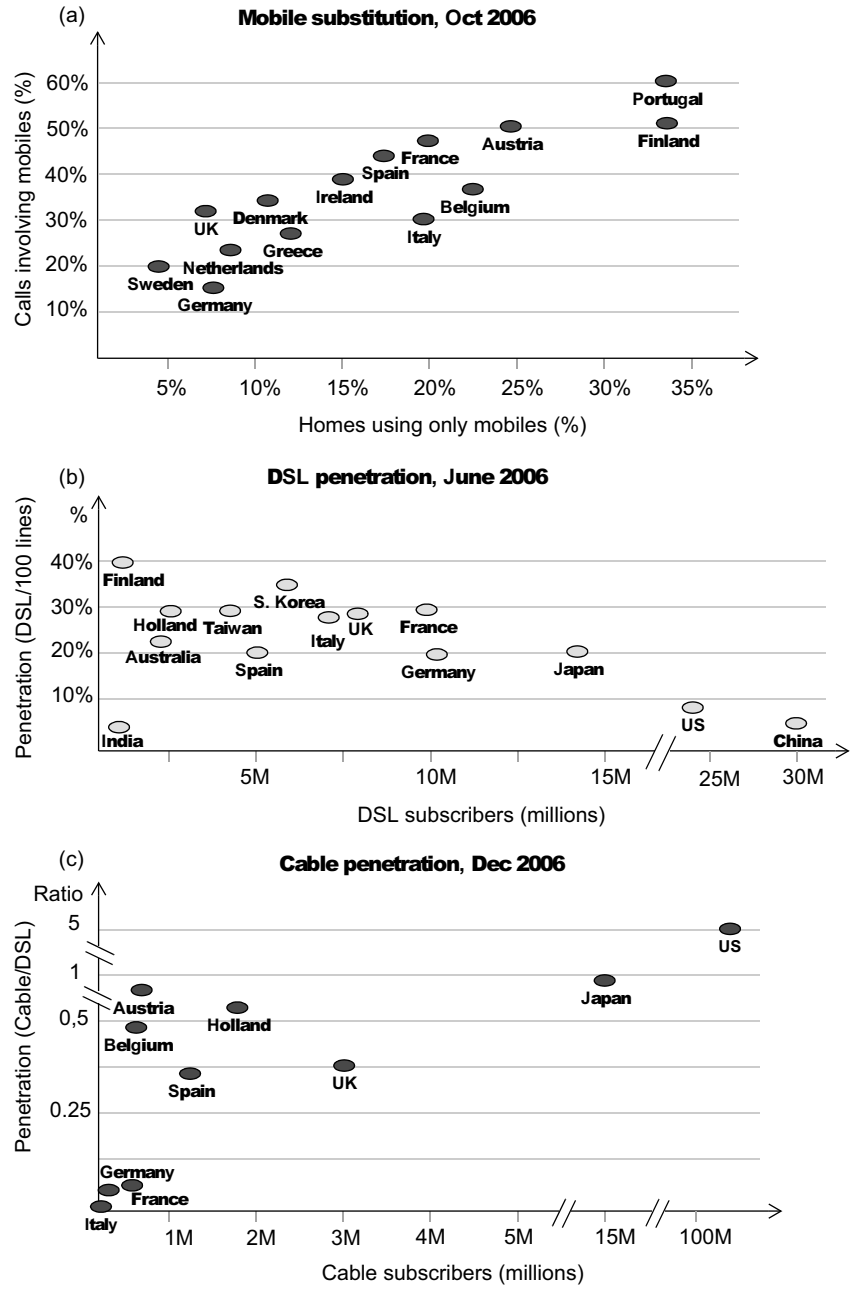

Figure 1-14. Mobile, DSL and cable penetrations. Reproduced by permission of (a) Trend Communications Ltd. (b) Reproduced by permission of DSL Forum; (c) Reproduced by permission of DSL Forum.

Bundling has become a protective strategy for incumbent operators, while in the hands of a competitive operator it is seen as an offensive strategy (see Table 1-3).

Faced with keen competition from free digital terrestrial television and from cable and satellite providers, telcos have opted for a third way, somewhere between free-to-view and pay-to-view TV. The difference will be that broadcasters and pay-to-view TV providers will offer a number of premium channels, while telcos will offer a competitive video-on-demand library.

1.4 Telcos Strategies

Strategies for Triple Play depend on a number of parameters such as business size, market position, competition and existing infrastructures (see Table 1-3). In the case of incumbent operators it is very important to obtain new revenues, while, at the same time, keeping the core and the access business in good shape because this has always been a competitive advantage.

A well planned strategy should follow a sequence of steps that will pave the way to Triple Play adoption:

1. Broadband access it must be periodically upgraded: ADSL, ADSL2+, VDSL2, and FTTP / FTTH (see Figure 1-19).

Table 1-3. How to face the competition and how to take decisions depending on business type.

		Competitor						
		Fixed	3G	Quadruple Play	ISP	Cable	Triple Play	Satellite
Operators and Strategies	*Fixed*	Price Quality Brand name	Enrich service VoIP, videocalls, multiplay Virtual mobile operator	Enrich service with VoIP, video calls, Triple Play	Include VoIP Triple Play	Include IPTV, bundle with mobile	Lower cost, move to Triple Play	TV, rural and isolated regions
	3G	Everything on wireless, move to 3G, HSDPA	Price Quality Brand name	Lower price, larger pipe	GPRS, UMTS	Mobility, mobile TV	Multi services over GPRS, 3G and HSDPA	TV, LEO constellation
	Quadruple Play	Convergence of fixed + mobile	Convergence of fixed + mobile	Price Quality Brand name	Fixed/mobile integration Divert calls to VoIP fixed using Wi-Fi	Fixed/mobile integration	Differentiate with mobile: quadruple play	TV channels
	ISP	Low cost VoIP calls	Low cost VoIP calls	Low cost VoIP calls	Price Quality Brand name	Low cost VoIP calls	Low cost VoIP calls	TV channels
	Cable	Include voice and broadband	Bundle all services enrich customization	Offer HD TV, bundle all services	TV channels	Contents Price Brand name	TV quality and quantity of channels	Contents
	Triple Play	Multiservice simplify billing, enrich contents	Enrich contents simplify billing, enrich contents	Multiservice simplify billing, enrich contents	Multiservice contents VoD	Focus on Price Support	Contents simultaneous channels Brand name	Multiple and VoD

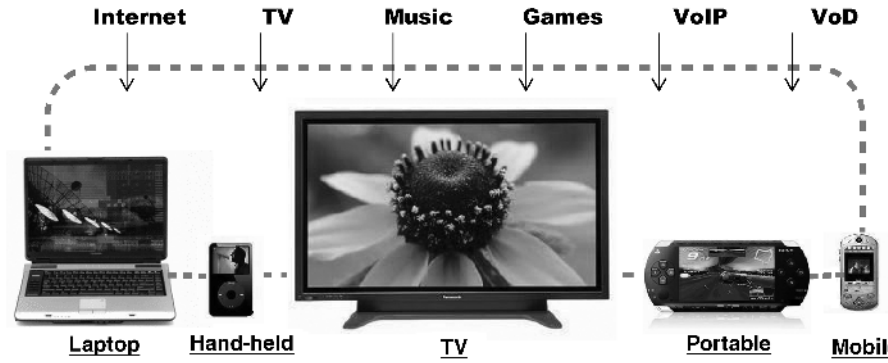

Figure 1-15. Triple Play is not only a matter of multiple information flows but is also about how a wide range of terminals can manage data, audio and video applications.

2. Progressive bundling of local/national/international calls to line rental and adding the Internet access.
3. Converged network rollout, to minimize cost in support and maintenance.
4. Mobile/fixed commercial bundling.
5. Add new applications such as IPTV, VoIP, Video conferencing.
6. Multimedia/multi-terminal services (see Figure 1-15)

1.4.1 Service Bundling and Network Convergence

The bundling process starts as a commercial action unifying in a bill of line rental, DSL service and phone calls. Obviously the first step is the integration of local and short distance calls while the most expensive international calls and calls to mobiles should be last, thus reducing the cost progressively.

Service bundling does not require either technological innovations or network migration. It can be accomplished just by means of market engineering and business alliances where necessary.

On the other hand, the network convergence term refers to the network based on SDH/SONET that is able to support all the Triple Play services simultaneously. It also refers to an IP centric architecture that is able to support different service quality accurately.

At the same time, the existing optical transmission core network has to be migrated into a packet-friendly core layer based on NG-SDH to facilitate the interconnection of the metropolitan that are being deployed based on bridged Ethernet architectures with QoS enablers like VPLS/MPLS.

Regarding the local loops, fibre will be progressively incorporated using FTTx architectures. Fibre will need to be installed in between the customer premises and the central office to reduce the copper span.

Although Triple Play strategies may start only with service bundling, migration to an IP-centric converged network needs to be part of the involved operators' strategy in order to reduce the delivery costs and simplify the management structure (see Figure 1-16).

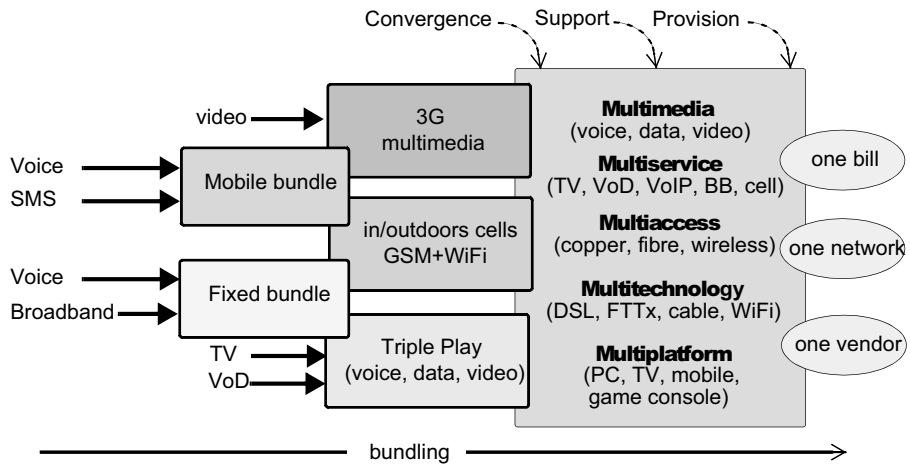

Figure 1-16. Triple Play migration. The big game.

1.4.2 Quadruple Play

When cellular phones are added, the bundle is often called Quadruple Play. However the new bundle is not necessarily a technological convergence, it could be a simple commercial package that only includes bill unification. But it can also be a sophisticated convergence that allows cellular hand sets to connect home routers to the Internet or to redirect calls through the cheaper fixed line. This convergence happens when the mobile is in the wireless hotspot range (wi-fi or bluetooth) of the router. Obviously, mobiles with Wi-Fi capacity are necessary to enable such a level of integration by making a seamless switch from the outdoor cell to the router range.

It is interesting to note that mobiles have their own Triple Play strategy, therefore Quadruple play does not really refer to new applications but to the inclusion of the wireless media and cellular hand sets in the bundle.

Mobile manufacturers and operators have demonstrated that multiple services and technologies can be merged successfully. We find it is quite normal to manage not only phone calls but also text and multimedia messages, agendas, navigation, Internet access, e-mail, radio, video, gaming, photographs, etc., using only our mobile terminal. Wireless operators have proved that it is possible to maintain or even increase revenues in a saturated market by offering innovative services and applications. These are interesting lessons to be learned by the new bundlers, namely, the fixed line operators.

1.4.2.1 Financial Integration

Integral operators, with fixed and mobile divisions, have more possibilities to protect their revenues from single network competitors. This strategy puts more elements into the operator's hands so they can be more aggressive on price than specialized ones. Integral operators can compete much better because they can move forces in both fields simultaneously to complement each other, thus reducing cost and using common staff, and assets. France Telecom and Telefonica are two examples that, by reabsorbing their mobile divisions, have become integral operators (see Figure 1-17).

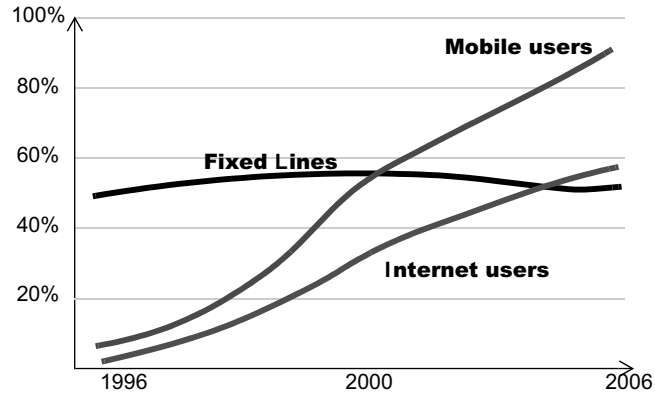

Figure 1-17. Fixed line, mobile and Internet penetration rates in developed countries. Reproduced by permission of International Telecommunications Union.

1.4.2.2 Combined Packages

Combined mobile and fixed services are a natural step forward for integral operators. This can be enhanced with unified features such as call forwarding, unified voice mail, and a common customer service centre. This action reduces mobile churn since it is economically convenient for subscribers and also more difficult for them to break the bundle or to change all fixed, DSL and mobiles services simultaneously, to move to a competitor.

1.4.2.3 Mobile Redirection

Calls originated in a cellular network can be redirected to the owner's fixed lines. To achieve this integration the router and the hand set have to establish a Wi-Fi or bluetooth link when they are close enough. Mobiles can also use broadband access to upload/download data, videos, music or to establish low cost VoIP calls over the Internet. This offer would cannibalize some of the revenues, but would also increase the loyalty of existing customers. Such is the case in Unik FT/Orange and BT Fusion, which are bundled services for mobiles that offer low call rates when the mobile user is at home by using the Wi-Fi connection to the router and then the Internet facilities.

1.4.3 VoD: the Key Difference

IP television is the direct way to face competition from cable operators in their core business. Television is a challenge in many aspects, because it requires a new network, a large access pipe, and rich contents to fill up the channels.

VoD can reuse an IPTV network; nevertheless it is a different service that requires new protocols, network elements and terminals to be supported. VoD requires rich libraries of specialized contents like films, documentaries, cartoons, sports, etc.

VoD is a key factor in the Triple Play offer, since broadcasters (cable operators, satellite, digital) have technical difficulties in implementing this service, therefore it can be seen as the front line to gain new customers and to increase the ARPU of existing.

1.4.4 Making a Success Story

In business there are many paths to failure and only a few to building a success story. Telcos should prepare the business case carefully, while the steps will depend on many parameters, the following being some of the most obvious. These are generic trends that every company can customize to their home markets.

- *Focus on urban customers*. A higher concentration of homes, buildings and a shorter distance to the central office is convenient for a quick rollout of the access network.
- *Target on high speed connections*. Customers already with broadband access are more likely to contract new bundled services.
- *Cost is the key factor*. Residential customers are very sensitive to cost, particularly when contracting commodities such as telephony, TV and broadband access.
- *IPTV is a defensive move*. Telcos, in principal, have to see TV services as a purely defensive blueprint to keep cable operators under control.
- *VoD is an offensive move*. Video services should be the front line strategy since only telcos have the most appropiate architecture to support it.
- *Prepare the convergence*. Mobile telephony vs fixed telephony competition is over. Integration of both worlds is strategic.
- *Keep it simple*. One bill, one provider, is probably less important than a service that is reliable, simple to manage by the customer and easy to maintain by the operator.

1.5 Infrastructures

Operators must keep in mind that the control and management of underlying resources are essential. For a successful Triple Play business case it will be necessary to roll out a converged network that is IP centric and QoS enabled. Independent of the access technology (DSL, FTTx, Cable, WiMax or Wi-Fi) and the core network architecture (VPLS, MPLS, Ethernet, NG SDH, or WDM), the converged network must guarantee the QoS to support data, voice and video streams.

Triple Play has different QoS requirements in terms of bandwidth and delays according to the application. For example video conferencing is sensitive to delay and jitter, but non-real-time multimedia applications are less sensitive to delay and packet loss because it makes use of error recovery techniques. While data applications are not sensitive to delay and jitter, packet loss may be a critical factor (see Figure 1-18).

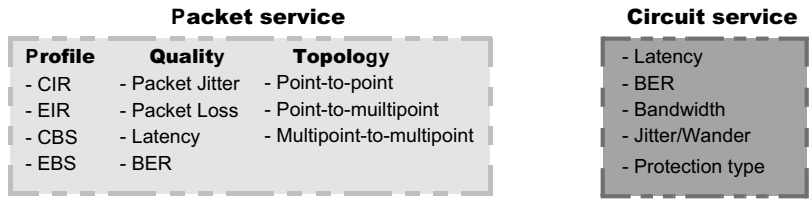

Figure 1-18. Parameters to consider when defining a packet or a circuit service.

There is a number of protocols and architectures to implement QoS in converged networks, including integrated services (IS), differenciated services (DS) and MPLS/VPLS.

1.5.1 CPE Equipment

Customer equipment varies depending on the access technology and manufacturers preferences but, independent of the access technology (copper, fiber, wireless), we need a router which generally has 10/100BASE-T interfaces, and eventually WiFi, to connect PCs, the set-top-box (STB), and IP phones (see Figure 1-4).

1.5.2 The First Mile

During the last decade a lot of progress has been achieved in access technologies. How many are suitable for delivering Triple Play? There are many certainly, based on DSL, cable, Ethernet, wireless and fibre, the cost to bandwidth ratio being the common selection criteria (see Figure 1-21).

Some telcos are installing fibre to the premises (FTTP), which is the best of the possible alternatives available in terms of bandwidth, but the high cost has persuaded many others to continue extracting more bandwidth from their copper pair loops, particularly if they are suitable for the installation of ADSL2+ and VDSL2 (see Figure 1-19). In general, fibre technologies, and specifically the Passive Optical Network (PON), have an associated higher CAPEX because they require fibre deployment to the customer's site, but a lower OPEX because all the elements are optical and passive, being exactly the opposite of copper technologies.

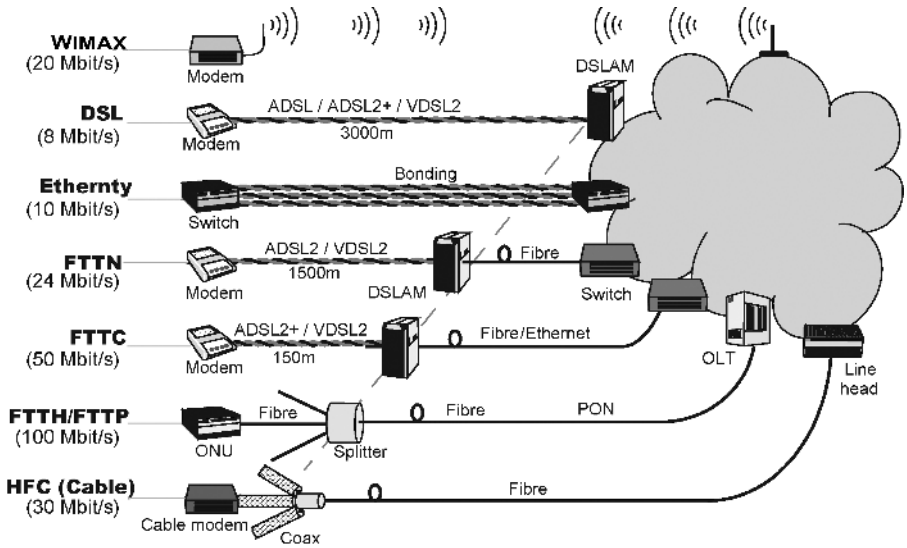

Figure 1-19. Broadband access technologies. Triple Play supports bandwidth hungry applications that require bandwidth of many Mbit/s.

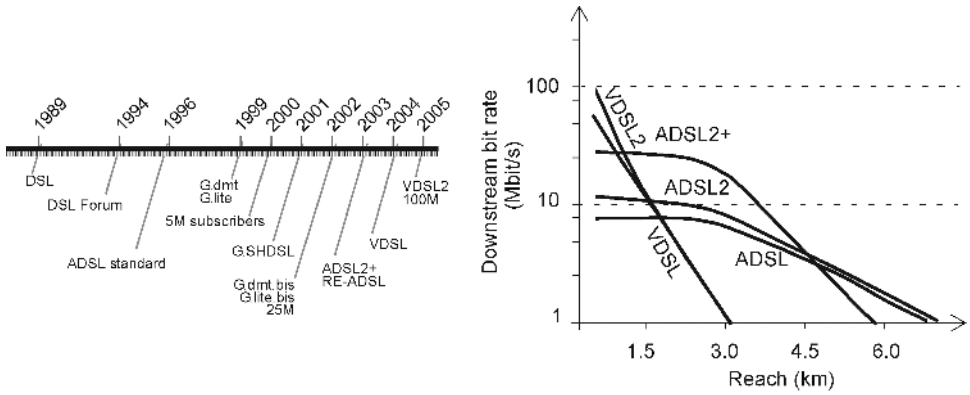

Figure 1-20. DSL has been a real success story in the number of subscribers thanks to its continuous evolution in speed and cost.

Cable operators use hybrid fibre coaxial (HFC), a technology that combines fibre optic and coaxial cable for the last span to the customer premises.

1.5.2.1 Digital Subscriber Loop

Copper loops are available everywhere whilst other media must be newly deployed. That is a competitive advantage for the owners of this infrastructure, who are generally incumbent operators. Several DSL technologies are possible, ADSL2+ and VDSL2 being the main alternatives for residential customers. They must guarantee a minimum of 6 Mbit/s to support one IPTV channel (see Figure 1-20).

Unfortunately, a high percentage of loops cannot reach the minimum bandwidth requirements for Triple Play. Factors related to physical characteristics and electromagnetic interferences like loop length, bridged taps, crosstalk and attenuation limit of the available bandwidth. All of these factors are influenced, directly or indirectly, by the distance between the DSL modem, or router, and the DSLAM. This the reason why there is an increasing tendency to reduce the span by installing DSLAM in street cabinets, in the neighbourhood or in the building.

1.5.2.2 Fibre to the Neighbourhood

The combination of copper and fibre in the loop is a compromise to offer higher bandwidth at reasonable costs. It is a step forward to continue extracting more bandwidth from the copper pair. Several architectures are possible (see Figure 1-19):

- *Fibre to the node (FTTN)*, the copper loop part, from the customer home, can be up to 1500 m long to reach the DSLAM which is, in turn, linked to the local exchange with fibre. FTTN has a reasonable rollout cost (cost could be between €300 and 500) while also increasing the number of enabled loops to transport television channels.
- *Fibre to the curb (FTTC)*, the fibre arrives at a street cabinet that connects homes within a distance of less than 150 m. A higher bandwidth would allow the delivery of more TV

channels simultaneously while the crosstalk, attenuation and noise on the copper are minimized with a shorter wire.

- *Fibre to the building (FTTB)*, the fibre arrives at the customer's home connecting the CPE and DSLAM over a distance less than 30 m. Higher bandwidth should be achieved because of a shorter copper section.

1.5.2.3 Optical Access

Fibre is the best media to deliver bandwidth higher than 50 Mbit/s, but it is necessary to figure out how to make it pay. The capacity of optical transmission is the ideal solution to bypass the bandwidth limitation on the last mile, but it is the most expensive. FTTP is based on PON or Active Ethernet and can deliver around 100 Mbit/s to each subscriber.

Fibre optic to the home is often a long-term strategy that is particularly appropriate for green-field installations but difficult to justify when alternative access solutions are already installed (see Figure 1-21). According to several consultancy companies, a home fibre connection can cost a provider anywhere between €600 and 2000 per subscriber, depending on how many difficulties arise. Existing neighbourhoods are the most expensive because it is often necessary to dig a ditch to reach every single home. In new developments it is easier and much cheaper when the fibre is installed together with water, gas, electricity and other utilities.

1.5.2.4 Cable Access

Cable operators use Hybrid Fibre Coaxial (HFC) to deliver dozens of simultaneous TV channels thanks to the big bandwidth pipe this technology can support. DOCSIS architectures enabled Internet access and, later on, VoIP was possible due to a very aggressive strategy to increase the market share of residential consumers of telecom services. However, telcos have used as the answer to deliver TV and VoD. This has made the cable operators business much more difficult.

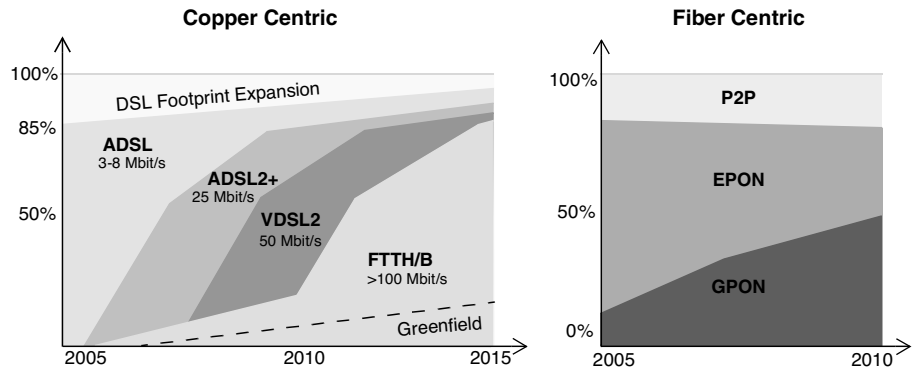

Figure 1-21. Forecast of broadband access technologies. Reproduced by permission of DSL Forum and Trend Communications Ltd.

1.5.2.5 Regulations

Regulatory factors may modify all the access strategies depending on how the unbundling legislation, that was applied to the copper local loops, affects the new access infrastructures:

- Will the regulations for unbundling the local loop be cancelled?
- Will the cable/fibre network be unbundled? This will depend on the unbundled resources: voice frequencies, packet traffic or full capacity.
- Will FTTx, together with wired access, be unbundled?

Obviously owners of fixed lines are applying pressure to prevent the introduction of more unbundling regulations that would allow third parties to use new optical and hybrid infrastructures.

However, there is a significant difference between what is happening on both sides of the Atlantic regarding regulations. In the US recent decisions are backing companies that are investing in infrastructures, while in Europe regulations affecting fibre optics are similar to those affecting the copper local loop.

It is also significant that the US has suppressed some of the unbundling obligations of the owners of cable infrastructures. According to the FCC the intention is to stimulate the investment in new FTTx infrastructures, then new access infrastructures will be offered at a reasonable cost to competitors but not at a regulated price. This decision is supported by the fact that alternative operators have already had time to develop their own business and access networks.

In Europe, new directives will abolish all regulatory distinctions between networks, telephone and the Internet, by placing all services and networks into a single, all-encompassing, regulatory category called 'electronic communications'. The consequence is that some European countries have opened up sub-loop access and optical access as well. These differences explain why the European Commission and National Governments are under pressure from the dominant operators to adopt the FCC model and keep new access technologies unregulated. The incentive is to justify the massive investments that will be required. So far, the result is heterogeneous, while in Germany BNetzA has permitted Deutche Telecom to close its VDSL-FTTN to competitors, while in the UK the regulator OFCOM has opened up sub-loop access.

1.5.3 Network Convergence

Despite the widespread availability of nx64 circuits, IP and Ethernet, two packet-oriented technologies, have been selected to build the Triple Play network (see Figure 1-18). The statistical multiplexing, typical of packet technologies, has important advantages. The first is cost, as they are much cheaper to roll out and maintain compared with circuit networks based on SDH. The second is that IP and Ethernet are easier to manage and have a lot of synergy with the Internet, which is based on the same principles. But probably the ability to implement any new service based on voice, data and video is even more important than the benefits mentioned above.

1.5.3.1 Is the IP Protocol Ready to do it?

IP is considered the best strategy to adopt in the deployment of the new converged services and particularly television, which has for a long time been offered exclusively by cable, terrestrial and satellite operators. The IP protocol differentiates telco portfolios from competitors. Native IP-centric infrastructures that were developed for data transport must be transformed into a multiservice platform also enabled to transport audio and video. To achieve this important investments are required.

The TCP/IP protocol was designed in 1983 and immediately adopted by the US Department of Defense to connect heterogeneous hosts. It has demonstrated itself to be very robust and suitable for managing large and complex topologies. Requiring a minimum of human intervention. The Internet that we know, developed during the 1990s, is an architecture that provides universal connectivity between heterogeneous but open subsystems. TCP/IP protocols are designed to automatically discover topologies and addresses by means of nodes and protocols that are continuously interchanging routing information.

IP networks are robust enough to maintain data flows between hosts but do not necessarily use the shortest or the most efficient route. It means that packet delay is unexpected and can even vary during the time a session is active. In IP networks what really matters is keeping datagrams flowing from source to destination whilst ensuring that they are independent of any events that can affect individual nodes. They are, in some respects, fault tolerant by nature.

Legacy TCP/IP architectures are best effort solutions that are good enough to transport data but are inappropriate for supporting voice or television which demand, not only an accurate QoS control, but also 99.999% availability, high performance and protection mechanisms. To achieve this the layered TCP/IP suite has adopted a number of protocols to emulate the predictable but inefficient circuits based on SDH. The result can be even better and more robust than legacy services when the right architecture is adopted (see Figure 1-22). Elements like SIP, RTP, RTCP, VPLS or GFP are only some of the protocols that can help IP to implement carrier-grade networks to support isochronic applications based on data, and also voice and video/TV.

1.5.3.2 Ethernet at Layer 2

Ethernet has a number of features that have made it the favourite technology for implementing architectures to support Triple Play services. Ethernet scores high in a combination of features like efficiency, simplicity, scalability and cost. It is also important that Ethernet is the technology used in the vast majority of customer premises and service provider installations.

Ethernet is efficient as it is packet-oriented, therefore it obtains the statistical multiplexing gain when transporting independent traffic flows over shared transmission medias. Ethernet is also very simple to set up and maintain, especially when compared with SDH-SONET installations. Other important considerations are the number of engineers and technicians, probably millions, that are confident with Ethernet and all its associated devices and protocols.

Ethernet is designed to be used with many types of optical and metallic media, and different bit rates. Transmission ranges and bandwidths are equivalent to long-haul

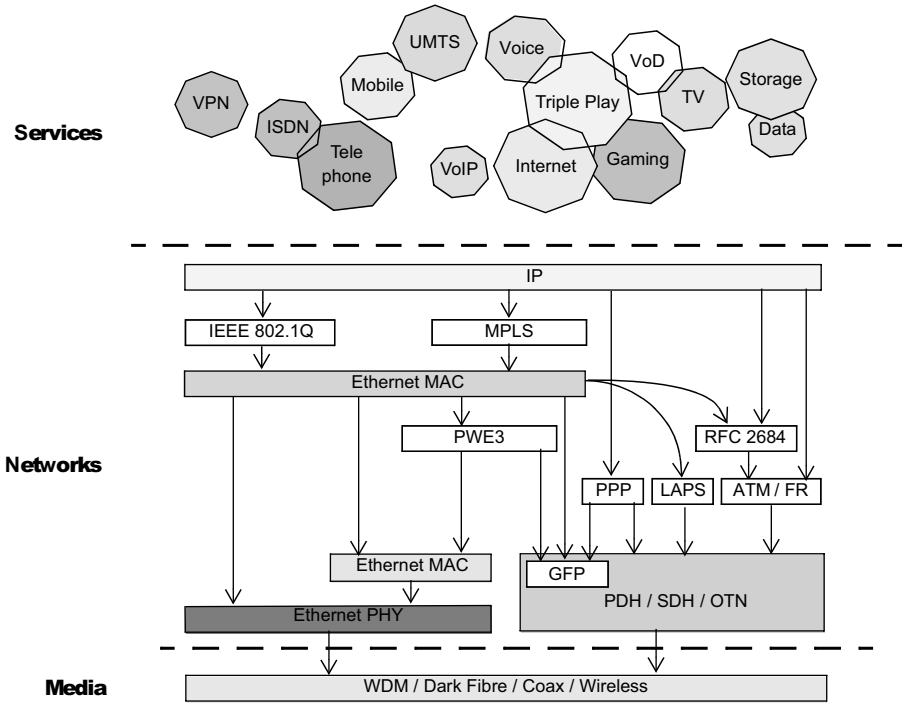

Figure 1-22. Applications, services and protocols.

technologies. Being easily scalable from a few Mbit/s up to many Gbit/s Transmission ranges and bandwidths are equivalent to long-haul technologies (see Table 1-4), it is therefore possible to migrate existing LANs, MANs and WANs to Ethernet using the existing physical media.

1.5.3.3 Ethernet Drawbacks

Unfortunately, native Ethernet lacks some essential functions necessary to supply 'carrier-class' services. Features like reliability, management, rollout, maintenance and QoS are much more demanding in Metro networks supporting Triple Play than in LANs where Ethernet is focused on data transport. Scalability can also be an issue. Ethernet switches work very well when the number of hosts connected is limited and during low traffic conditions, but as soon as the installation grows it tends to degrade in performance, QoS, security and availability.

When Ethernet is extended beyond the LAN, several architectures can fulfil the requirements, including Dark Fibre, DWDM/CWDM, NG-SDH (see Figure 1-23). In principle, all of these architectures are able to support the carrier Ethernet service classes like E-Line, E-LAN and E-Tree, nevertheless some are more appropriate than others.

Depending on the requirements of the applications, budget, customer profile, installed base, optical infrastructure and capacity are more important factors to consider.

Table 1-4. IEEE 802.3 Ethernet versions

	Interface	Media type	Mbps	FDX	Encoding		MFS	Reach
					Data	Symbol		
Ethernet IEEE 802.3a-t	10BASE-2	One 50 Ohm thin coaxial cable	10	H	4B/5B	Manchester	64	<185 m
	10BASE-5	One 50 Ohm thick coaxial cable	10	H	4B/5B	Manchester	64	<500 m
	10Broad36	One 75 Ohm coaxial (CATV)	10	H	4B/5B	Manchester	64	<3600 m
	10BASE-T	Two pairs of UTP 3 (or better)	10	H/F	4B/5B	Manchester	64	<100 m
	10BASE-FP	Two optical MMF passive hub	10	H	4B/5B	Manchester	64	<1000 m
	10BASE-FL	Two optical MMF asyn hub	10	F	4B/5B	Manchester	64	2000 m
	10BASE-FB	Two optical MMF sync hub	10	H	4B/5B	Manchester	64	<2000 m
Fast Ethernet IEEE 802.3u	100BASE-T4	Four pairs of UTP 3 (or better)	100	H	8B/6T	MLT3	64	<100 m
	100BASE-T2	Two pairs of UTP 3 (or better)	100	H/F	PAM5×5	PAM5	64	<100 m
	100BASE-TX	Two pairs of UTP 5 (or better)	100	H/F	4B/5B	MLT3	64	<100 m
	100BASE-TX	Two pairs of STP cables	100	F	4B/5B	MLT3	64	200 m
	100BASE-FX	Two optical MMF	100	F	4B/5B	NRZI	64	2 km
Gigabit Ethernet IEEE 802.3z/ab	1000BASE-CX	Two pairs 150 Ohm STP (twinax)	1000	F	8B/10B	NRZ	416	25 m
	1000BASE-T	Four pair UTP 5 (or better)	1000	H/F	4D-PAM5	PAM5	520	<100 m
	1000BASE-SX	Two MMF, 850 nm	1000	F	8B/10B	NRZ	416	500/750 m
	1000BASE-SX	Two MMF, 850 nm	1000	F	8B/10B	NRZ	416	220/400 m
	1000BASE-LX	Two MMF, 1310 nm	1000	F	8B/10B	NRZ	416	< 2 km
	1000BASE-LX	Two MMF, 1310 nm	1000	F	8B/10B	NRZ	416	<1 km
	1000BASE-LX	Two SMF,1310 nm	1000	F	8B/10B	NRZ	416	5 km
	1000BASE-ZX	Two SMF, 1310 nm	1000	F	8B/10B	NRZ	416	80 km
10G Ethernet IEEE 802.3ae	10GBASE-SR	Two MMF, 850 nm	10000	F	64B/66B	NRZ	N/A	2–300 m
	10GBASE-SW	Two MMF, 850 nm	10000	F	64B/66B	NRZ	N/A	2–33 m
	10GBASE-LX4	Two MMF, 4 × DWM signal	10000	F	8B/10B	NRZ	N/A	300 m
	10GBASE-LX4	Two MMF, 4 × DWM signal	10000	F	8B/10B	NRZ	N/A	300 m
	10GBASE-LX4	Two SMF, 1310 nm, 4 × DWM	10000	F	8B/10B	NRZ	N/A	10 km
	10GBASE-LR	Two SMF, 1310 nm	10000	F	64B/66B	NRZ	N/A	10 km
	10GBASE-LW	Two SMF, 1310 nm	10000	F	64B/66B	NRZ	N/A	10 km
	10GBASE-ER	Two SMF, 1550 nm	10000	F	64B/66B	NRZ	N/A	2–40 km
	10GBASE-EW	Two SMF, 1550 nm	10000	F	64B/66B	NRZ	N/A	2–40 km
Ethernet First Mile IEEE 802.3ah	100BASE-LX10	Two SMF, 1310 nm	100	F	4B/5B	NRZI	N/A	10 km
	100BASE-BX10	One SMF, 1310 (U)/1550 (D)	100	F	4B/5B	NRZI	N/A	10 km
	1000BASE-LX10	Two SMF, 1310 nm	1000	F	8B/10B	NRZ	N/A	10 km
	1000BASE-LX10	Two MMF, 850 nm	1000	F	8B/10B	NRZ	N/A	550 m
	1000BASE-BX10	One SMF 1310 nm (U)/1490 nm (D)	1000	F	8B/10B	NRZ	N/A	10 km
	1000BASE-PX10	One SMF, PON 1310 nm (U)/1490 nm (D)	1000	F	8B/10B	NRZ	N/A	10 km
	1000BASE-PX20	One SMF, PON 1310 nm (U)/1490 nm (D)	1000	F	8B/10B	NRZ	N/A	20 km
	10PASS-TS	One or more telephone pairs	10	F	64/65-octet	T1.424	N/A	750 m
	2BASE-TL	One or more telephone pairs	2	F	64/65-octet	G.991.2	N/A	2.7 km

List of acronyms: H: half-duplex; F: full-duplex MFS, minimum frame size in bytes; N/A, not applicable; MMF, multimode fibre; SMF, single mode fibre; U, up stream; D, down stream

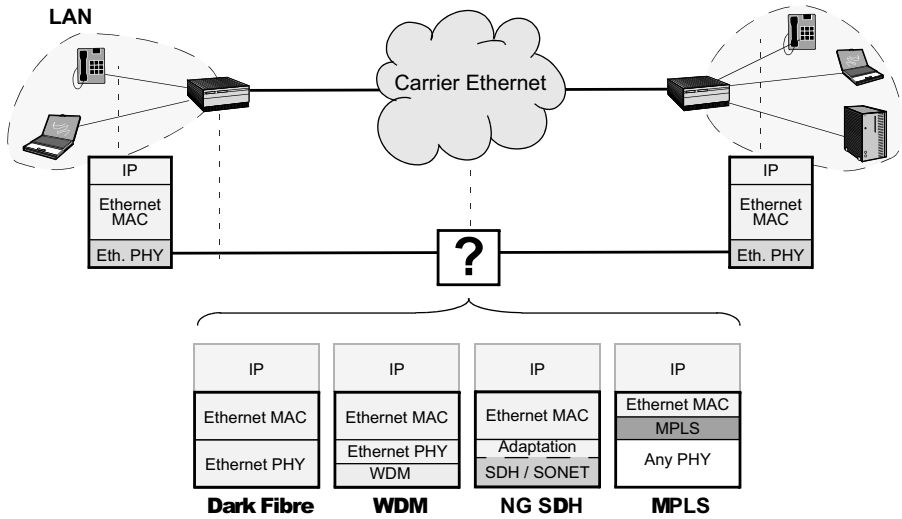

Figure 1-23. Alternatives for providing carrier Ethernet services.

1.6 Triple Play Market

Important growth that can be expected in the residential market for Triple Play services in the US has been calculated at 32 million subscribers annually (Yankee Group August 2006), with an average operator spending rate of about $4000 per subscriber. Pyramid research is not so optimistic, calculating a world market of 35 million subscribers by 2010 (see Figure 1-24). According to Gartner research, the current average combined monthly spend that includes fixed voice, Internet and TV in Europe is €93.70. This roughly matches Fastweb reports in Italy of obtaining an ARPU of €900 a year so the ARPU can be increased by 100% after the adoption of bundled services.

It is necessary to warn that low revenue expectations and the high investments needed for Triple Play could result in significant losses for telecom operators that in some cases can cause an initial cumulative loss higher than €2000 per subscriber (see Figure 1-25).

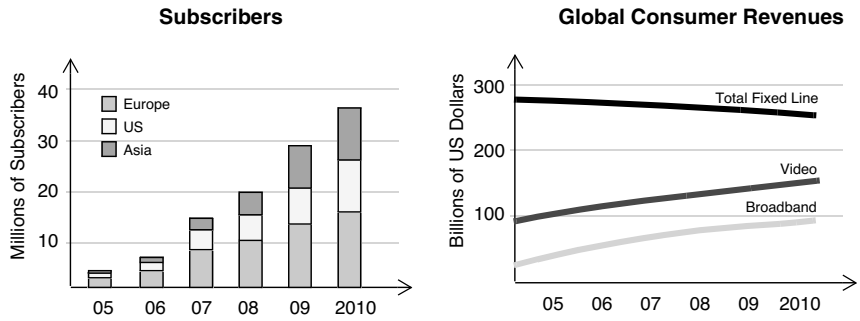

Figure 1-24. Triple Play subscribers and revenues prediction. Reproduced by permission of Trend Communications Ltd.

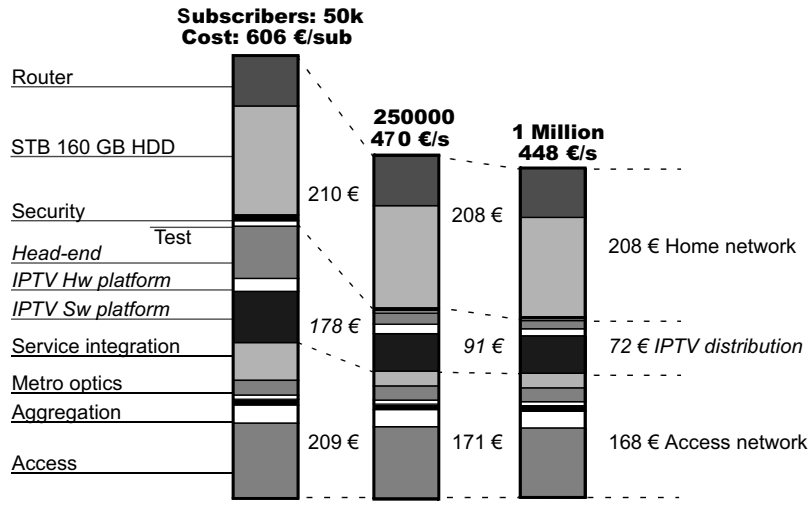

Figure 1-25. Triple Play deployment cost and the scale economies. Reproduced by permission of Alcatel-Lucent © 2007.

Caution is necessary. Several of the most relevant European cable companies providing Triple Play services are not growing quickly, and in some cases, are even losing market share. Put quite simply, many potential subscribers are not interested in having one provider for the three services (*Les Echos* 26 September 2006 and others).

1.6.1 Warning: No Immediate Profit is Expected

1.6.1.1 Providers' View

The size of the broadcast and cable TV market has been calculated to be about 25% of the whole telecom business, and this is a good reason for telcos to go into this business (see Figure 1-9). But the provision of TV has a major impact on telecommunications architectures. Massive investments are required to transform legacy networks into multiservice platforms.

This is the million dollar question. Will service providers get any benefits at all? Triple Play's main message is 'more services for less money' (see Table 1-5). How is it really possible for operators to increase revenues? If the answer is not clear for Triple Play operators it is even more difficult for single service operators. How can they compete against an efficient multiservice network that can deliver any type of application and also integrates mobiles? This is a good point to consider: the cost of not embracing a Triple Play project.

1.6.1.2 Customers' View

The growing enthusiasm for bundling video with existing services demands high investments but customers are not willing to pay a lot for new TV channels since it is a mature service already supplied by broadcast, cable, digital, terrestrial TV and satellite (see Figure 1-10).

Table 1-5. IPTV Customer offering[a]

Service provider	Movies	TV contents	Songs	Other
T-Com Germany	1500 titles	1500 h	Unknown	Sport services
Chunghwa Telecom	Unknown	Unknown	6000	Karaoke
Telefonica	200 titles	1500 h	1600	Sport services
Virgin Media	500+ titles	Last week's TV	1000+	Adult services
Sky TV	200+ titles	Up to 40 h	Unknown	Sport services
BT-Vision	200+ titles	Unknown	150+	15+ games

[a]*Source: Alcatel-Lucent*. (Reproduced by permission of Alcatel-Lucent © 2007)

Therefore, from a subscriber point of view, the true value of Triple Play is not exactly the addition of TV; it is the convenience of a bundled package that can be simpler and cheaper.

Competition is now even more extreme but the customer base remains the same. Therefore it is urgent to stimulate the demand with new services and applications that can generate more revenue. Otherwise many companies could be at risk of not recovering their investments.

1.7 Conclusions

Services bundling and network convergence are different facets of the same strategy, since it is not possible to offer a competitive package, with many varied services, without a network that reduces delivery costs and simplifies the management.

Bundling is the strategy to adopt in order to compete and differentiate the portfolio in mature telecoms markets. Telcos with mobile and fixed networks are moving towards a wholesale business by integrating separate divisions. Single service operators are signing up to alliances with other operators to enrich their services to offer a more comprehensive portfolio that would ideally include wireless, fixed access, voice, video and data. This is also the case for some fixed line operators that may also offer wireless access or those mobile operators that have opened up their network to offer wire based services.

Network convergence is a trend that most operators are having to face (see Figure 1-26). But, will this strategy produce profits? The question is how to bundle multiple services for less money while combining both mobile and fixed networks.

It is still too early to say if Triple Play will be commercially successful. It is a new strategy with many technical challenges and scalability problems ahead. Cable operators are not taking any risks at the moment because they are already one step ahead, as they have already added broadband access and voice to television, their core business. But we should not underestimate the greater variety of services that telcos can offer with the flexible IP-based architectures.

Regarding Triple Play rollout, there are a number of challenges to fulfill. Voice, television, video and broadband access all have different traffic profiles and place different requirements on the network that delivers these services. Voice and television are affected by jitter, while packet loss has a greater effect on video and data services. Consequently, accurate quality of service mechanisms are necessary to develop and control the delivery of Triple Play.

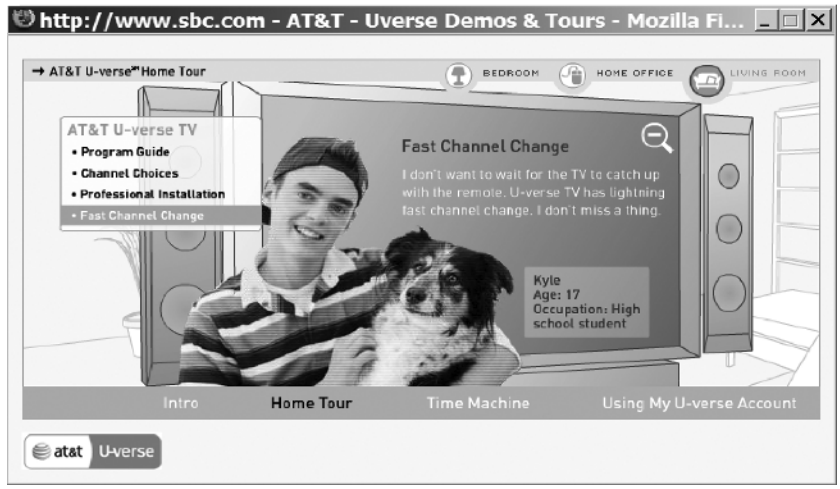

Figure 1-26. Fading phone business pushes companies in a new direction: Triple Play, like AT&T and its U-verse service offers IPTV, VoD, broadband access (wired and wireless), music downloads, gaming, integrated video recording, integrated ISP portals, VoIP, IP video conferencing and file sharing.

In some ways we can find certain similarities with old convergence strategies that happened in the industry during the last few decades. Some of them were successful, like the ISDN convergence of voice and data, but others for example ATM, were not at all able to steal the limelight on the convergence stage. Another recent case of a failed convergence has been 3G, when wireless European operators paid a fortune to operate 3G networks that would also deliver a bundle of voice, data and video services. It must be frustrating when the new 3G services are sold as just offering low-cost calls.

Therefore companies embracing bundling and convergence should take precautions to avoid repeating the same errors.

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