DA 1.1 – Towards multi-service business models

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ABBREVIATIONS

A&R	Accounting & Reading
ADSL	Asynchrony Digital Subscriber Line
ANP	Access Network Provider
ARPU	Average Revenue Per User
ASP	Access service Provider
B&C	Billing & Charging
B2B	Business to Business
B2C	Business to Consumer
C&A	Charging & Accounting
CAAG	Central Arizona Association of Governments
CAPEX	Capital Expenditures
CI	Configuration Interface
CPE	Customer Premises Equipment
CRM	Customer Relationship Management
DAS	Direct Attached Storage
DI	Data Interface
DRM	Digital Rights Management
DVR	Digital Video Recorder
EMEA	Europe, Middle East and Africa
ERP	Enterprise Resource Planning
FCC	Federal Communications Commission
IP	Internet Protocol
IPTV	Internet Protocol Television
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ITU-T	International Telecommunication Union – Telecommunication standardisation sector
LAN	Local Area Network
LP	Loop Provider
NAS	Network Attached Storage
NGN	Next Generation Network
NSP	Network Service Provider
OECD	Organisation for Economic Co-operation and Development
OPEX	Operational Expenditures
OPTA	Onafhankelijke Post en Telecommunicatie Autoriteit - which means Independent Post and Telecommunications Authority
OSGi	Open Services Gateway Initiative
PI	Policy Interface

PMP	Paris Metro Pricing
PSTN	Public Switched Telephony Network
PVR	The Personal Video Recorder
QoS	Quality of Service
R&M	Reading & Metering
RNP	Regional Network Provider
RSVP	Request for Reservation Protocol
RT	Real Time
SAN	Storage Area Network
SME	Small and Medium size Enterprise
SLA	Service Level Agreements
SOHO	Small Office, Home Office
TONIC	Techno economics of IP Optimised Networks and Services
ULL	Unbundling Local Loop
VCR	Video Cassette Recorder
VoD	Video on Demand
VoIP	Voice over IP
VPN	Virtual Private Network
Wi-Fi	Wireless Fidelity (IEEE 802.11x)
xDSL	Digital Subscriber Line

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EXECUTIVE SUMMARY

This work that has been performed within the MUSE Working Package A1 related to the business models did mainly focus on the further development of the business role definition of the DSL Forum TR058 (1), the definition of the related sound business models and the determination of the total potential market of the new services/ reference applications. Furthermore based on the former IST TONIC work (2) it gives some guidance in order to apply the sound business models to the various MUSE techno-economic case studies within the WPA3.

In order to provide more flexibility in describing (future) business models two new roles compared to the DSL Forum TR058 (1) has been developed which are:

- Packager (P) and
- Connectivity Provider (CP).

The Packager supports the Customer (single point of contact) and combines (by means of SLAs) access network services, on the one hand, with core network services and applications services on the other hand.

The Connectivity Provider is responsible for the end-to-end connectivity between CPE and the NSP/ASP and combines the access service (by the ASP) and the regional network service (by the RNP).

Beside the introduction of important business model flavours as Service Provider Focused Model (Wholesale Model), Network Operator Focused Model, Independent Service Provider Model and Super Provider Model (Vertical Integration Model) the deliverable highlights one approach of the public-private- partnership, where broadband access is ensured by connecting independent networks of Municipality's and County's. The main difference compared to the other business models is that the roles of Access Network Provider and Connectivity Provider are taken by different entities.

The major challenges of the MUSE techno-economical evaluations are to find the business model influence of the new multi service characteristics for the various players. For this purpose this deliverable gives some guidance regarding the multiple parameters which should be considered in order to apply the different multi service business models to the various MUSE techno-economic case studies within the WPA3.

Furthermore this deliverable supports the choice of potential business models that will be investigated within WPA3 in order to secure an interesting outcome for all involved.

In general the deliverable raises not the claim of completeness but rather it should be understand as a collection of possible generic business model approaches.

INTRODUCTION

The deliverable establishes the different service business roles in an open business model, access network provider, network service provide, application provider and content provider. It provides insights on what agent behaviours will promote applications that generate revenue for the network provider.

This deliverable supports the choice of potential business models that will be investigated within WPA3 in order to secure an interesting outcome for all involved. It gives some guidance how to approach the business modelling for the assessment and definition of use cases in milestone MA3.2 respectively the DA3.1.

The introduction of the value chain and the definition of the roles that can be taken by different major players in order to establish various business models in the field of broadband telecommunication by offering multi-services has been described in the first part.

The second part tries to estimate the total potential market size and the potential market revenues of the new services/ reference applications based on several different sources.

The sound business model chapter then introduces the most important business model flavours based on the value chain definitions which are:

- Service Provider Focused Model (Wholesale Model)
- Network Operator Focused Model
- Independent Service Provider Model
- Super Provider Model (Vertical Integration)

For these major business models some real examples are given. In general numerous business models are possible based on different combinations and extensions or detailed differentiations of the different players.

This document highlights one approach of the public-private- partnership, where broadband access is ensured by connecting independent networks of Municipality's and County's.

In the region of Aarhus a number of commercial, public and private BB networks are working independently. It is very interesting to see a feasible way to connect all these BB networks.

The main difference compared to the other business models is that the roles of Access Network Provider and Connectivity Provider are taken by different entities.

There is however a number of obstacles and issues which must be solved before this can be done:

- There has to be a shared vision of the potential gains for all parties and the region as a whole.
- The political will must be there to connect the BB networks of the municipality and the county.
- The technological issues related to the present and future infrastructure must be dealt with.
- The main private operator (formerly state owned telecom) as one of the regions largest company through its tight connections with the municipality tries to keep new BB initiatives down.

The “Assessment for Further Evaluation” chapter gives some guidance how to approach the business modelling for the assessment and definition of use cases in milestone MA3.2 respectively the DA3.1. It starts with some basic modelling functions in order to introduce the general elasticity of the demand influenced by different pricing levels (discrimination), service attractiveness and willingness to pay.

In the Annex the Portugal Case Study intends to present the recent evolution of Portuguese tariffs and penetration rates of Internet broadband services.

1 VALUE CHAIN

1.1 Introduction

Until now, a strong relation between, on the one hand, the services and, on the other hand, the network and devices existed. Broadcast TV was always delivered via coaxial cable networks to TVs, telephony services via twisted pair copper cables to telephones and telephony equipment, and Internet services via POTS or ISDN dial-up connections to PCs. A trend towards a decoupling of services and networks is becoming apparent: voice services are offered via coax networks, music and video via data networks, which themselves can now be realized both via copper twisted pair networks and coaxial cable networks. Service providers will be able to deliver their services via different networks, and more than one service can be delivered by each network. This trend is called unbundling of the value chain and it will continue in the coming years (see Figure 1).

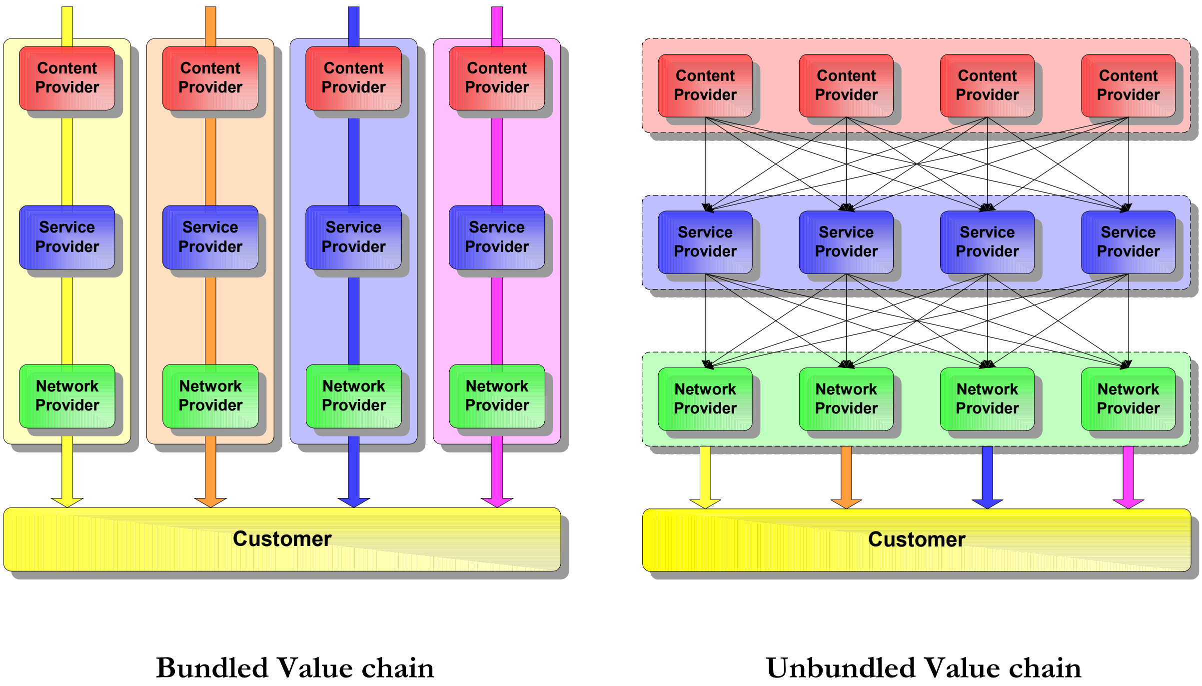


Figure 1, The bundled and unbundled Value Chain

Figure 1 gives an example of service delivery value chains in a bundled telecommunication market (left) and in an unbundled market (right). In the unbundled value chain, it is possible to package content, services, or networks to limit the number of possible relations, as is indicated by the light-coloured horizontal areas.

The value chain is sometimes defined as “A vertical alliance of enterprises collaborating to achieve a more rewarding position in the marketplace”. Because of the large diversity of services that can be offered over access networks and players that could be involved, it is not practical to consider every possible service delivery value chain separately. Instead, it is more efficient to identify generic roles with a clear function and responsibility in the service delivery process. In concrete cases, the same company can fulfil more than one role.

The importance of the different roles is not the same in every situation. It is even possible that specific roles are absent. E.g. a content provider role is absent if a specific service (e.g. a burglar alarm service) does not involve content, while in other cases (e.g. Video on Demand) the content provider role is very pronounced.

1.2 Business roles

This section gives a high level description of the MUSE business roles and addresses the relationships between the various roles. The role model can be considered as an extension to the model described in the DSLForum document TR-058 (1). However the business role model and how to use such a model was also inspired on the TINA model presented in (3). Two major changes were made with respect to the DSLForum model. The first change is that the DSLForum NSP role was split into two separate roles, namely the Packager role and a new NSP role with a smaller set of responsibilities than the DSLForum NSP role. By introducing the Packager role it becomes possible to set apart certain tasks that are specific to the customer relationship and that has less to do with controlling a network. It is expected that this extension will not have much impact on the reference architecture as presented in other MUSE documents such as MA2.3.

The second change involves the introduction of another new business role, the Connectivity Provider. This role can be regarded as an umbrella role for the Access Network Provider and the Regional Network Provider. This role was added for the reason that in real life cases end-to-end connectivity between the CPE and the NSP or ASP network is often provided by the same party that also takes care of the authentication of Customers on behalf of the NSP and ASP. More details about the specific tasks of each role are given in following sections.

Again, it is emphasised that in real-life cases actors will generally act a bit different from the roles presented in this section. Roles basically represent tasks that are grouped in a logical way and are created by definition. Actors, on the other hand, are the players in real-life; they fulfil one or more of these defined business roles. The reason to use business roles, instead of talking about real existing actors, is to have a common terminology throughout the whole MUSE project and a common understanding of what these roles exactly do. The way actors act may change in the course of time and can differ between countries, while the definitions of roles stay the same. Naturally, the mapping of actors onto the role model will also change. The degree of separation that has been applied to in this model, reflects the maximum degree of unbundling that would be expected to happen in real-life situations. For that reason, in a lot of situations actors fulfil more than just one role (see also the Sound Business Model chapter).

A line between two roles (Figure 2) means that there exists a business relationship between two different players (companies or business units within a company) that fulfil these roles; no line also means that there is no such a relationship between two different actors/roles[1]. If in a real-life case it turns out that an actor who mainly fulfils the Connectivity Provider role has a direct relationship with the consumer, e.g. for billing reasons, it is said that this actor partly fulfils the Packager role as well. For that reason there has not been a line drawn between the Customer role and the Connectivity Provider role.

In the next sections, the various roles are discussed. Particularly for the Customer and Content Provider role, lists of requirements have been included, since a number of these may easily be forgotten if the focus is on network requirements.

[1] Notice that the lines do not necessarily have to correspond with physical connection in a network architecture that is used for the service delivery.

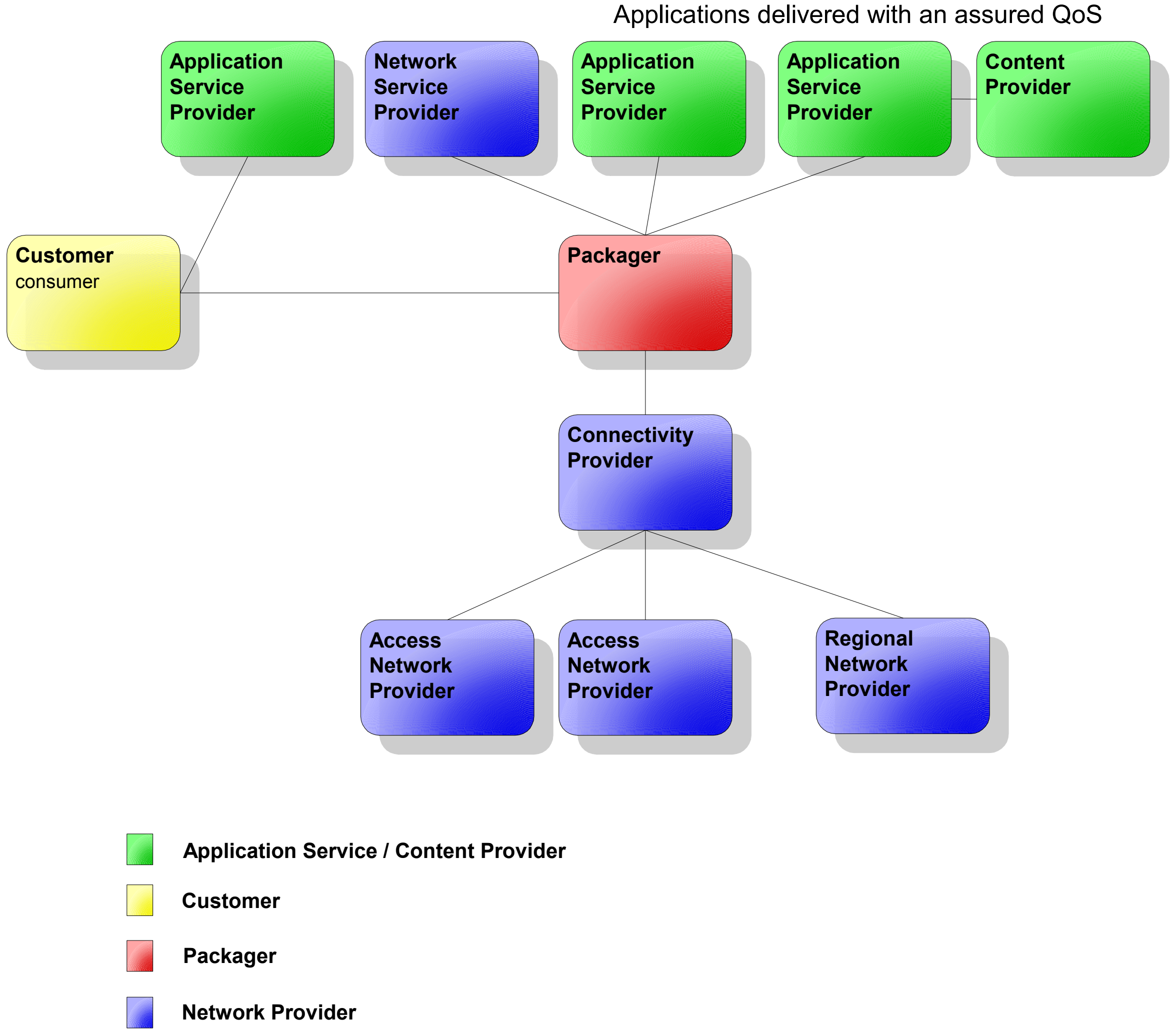


Figure 2 Business Service Roles.

The lines between the various roles Figure 2 represent the business relations (in the ideal situation) and not the structure of the network. The figure shows that a (actor fulfilling the role of) Connectivity Provider can have a business relation with multiple access network providers. Likewise the packager may have relations with multiple connectivity providers and network service providers as well. However, this is not explicitly indicated in the figure.

1.2.1 Customer

The Customer consumes the services delivered by the service providers. The Customer can be a person or a family, but also a company. If the Customer role is actually fulfilled by a physical person, this person is called the consumer. The consumer could also fulfil other roles in addition to the Customer role.

The Customer has a business relation with the Packager, who may offer him an Internet connection and/or connectivity to a number of Application Service Providers. The Packager acts as the single point of contact to the Customer for network services, but may also be the point of contact for a number of applications that are sold under his brand (e.g. email and web page hosting facilities).

The Customer can consume services from Application Service Providers that have a business relationship with his Packager or from ASPs that do not have any relationship with the Customer's Packager, e.g. because they offer their services via the World Wide Web. In the latter case the service can not be delivered with an assured QoS.

1.2.1.1 Customer Premises Network (CPN)

The Customer owns a Customer Premises Network or a Company Network. In case of a residential user the Customer Premises Network is connected to the Access Network through a CPE. This device can fulfil the simple function of a bridge but can also have routing functionality or even functionality that allows dynamic installation of services and applications on the CPE. These kind of CPEs are sometimes called Routing Gateway or Residential Gateway.

1.2.2 Packager

The Packager role has a central place in the business role model. He combines access network functionality from Access Network Providers (ANPs) with core network (Internet, corporate networks) functionality from one or more NSPs or/and application services from one or more ASPs and offers this as a package to the Customer. The Packager is of great value to the Customer as he gives the Customer advise on the modem type and the bandwidth subscription that fits best to the his needs. The Packager is also the single point of contact to Customers with respect to a number application that require an assured QoS in the network and in situations where the Customer experiences trouble with a service he has subscribed to via the Packager.

The Packager role is a bit complicated in the sense that in practise (a part of) this role is often fulfilled by actors who fulfil one or more other roles as well. Currently, ISPs being responsible for the NSP role, generally fulfil most of the Packager role. The reason for introducing a separate Packager role is to stress the importance of some of the tasks performed by this role. For example, it is envisioned that in situations where the Customer uses services provided by multiple ASPs/NSPs it is necessary to have one (central) actor who has an overview of all the different services (network and application) the Customer has subscribed to, especially when these services require certain QoS settings in the network (access and regional) or CPE. The Packager has this information. For that reason, the management of the Auto-configuration Server (see MA2.3) is a task that could belong to the Packager role very well.

On the other hand, from the Customer point of view, it would be convenient for him to have one point of contact for (most of) his services, especially in situations where one or more services do not function anymore.

In general the Packager is technology agnostic. All the technology related aspects of the contract with the Costumer are put as requirements to the technology specific Connectivity provider. As such the Packager hides away all technology from the end user while at the same time is the single point of contact to the Costumer. The Packager may also interface other Packagers in order to provide “nomadism” services. A costumer may be able to connect to a “foreign” network if a service agreement exists between the corresponding Packagers enabling them to exchange billing information, user profiles and network requirements. It is the responsibility of the home Packager to put requirements on the “foreign” Packager in order to be in line to its initial contract with the Costumer.

An example which shows that the Packager role has not completely been fulfilled by a single party can be seen in the Netherlands. There the Customer deals with the ISP and KPN in order to get Internet access over ADSL. KPN mainly fulfils the Connectivity Provider role but contacts the consumer directly for issues related to network connectivity. Also in case of line failures the consumer can directly contact KPN. Further, KPN sends the bill for network connectivity directly to the consumer. This shows that KPN fulfils, besides the Connectivity Provider role, parts of the Packager role as well.

A situation where multiple players fulfil parts of the Packager role may be confusing to (less technical scaled) consumers and is therefore considered as less ideal.

In the future the Packager role may be extended with tasks related to the control of the home gateway and the home network in order to further relieve the Customer of complex (configuration management).

To conclude with, it is assumed that there will not be more than one Packager per Customer per CPE (gateway). Otherwise, the Packager role is considered to be divided among multiple actors. The Packager role allows Customers to have connections with multiple NSPs/ASPs while at the same time QoS can be assured. He takes also care that the Customer can not subscribe to (more) services than his CPE or network connection supports. Finally, the Packager can also be the one who collects billing information for the various services and sends an integral bill to the Customer.

1.2.3 Connectivity Provider

The Connectivity Provider is overall responsible for providing end-to-end connectivity between the CPE (gateway) and the NSP or ASP network, guaranteeing the agreed QoS and security characteristics. The Connectivity Provider has SLAs with the Access Network Provider and the Regional Network Provider regarding the required network resources. The Connectivity Provider can do authentication and the assignment of IP addresses to CPE on behalf of the NSP or ASP. Further, the Connectivity Provider may assemble billing information from network services and provide this to the Packager.

In general, there will not be more than one Connectivity Provider per CPE, since otherwise it will be hard to control the total amount of bandwidth that a Customer may use. In practise, the connectivity provider role is often combined with the Access Network Provider role or the Regional Network Provider role (This is the case in TR-058).

1.2.4 Access Network Provider (ANP)

The Access Network Provider is responsible for OSI layer 1 and 2 transport between the CPE and the edge router. He takes appropriate measures in his network in order to have sufficient resources available to guarantee the agreed QoS. An ANP can offer his network service to multiple Connectivity Providers.

1.2.5 Regional Network Provider (RNP)

The Regional Network Provider aggregates traffic from different edge nodes and delivers this to the right NSP or ASP. He may offer his network services to multiple Connectivity Providers.

1.2.6 Loop provider

The Loop Provider (not shown in Figure 2) is responsible for building the physical infrastructure in the Access Network. He has a business relationship with only the Access Network Provider.

The Loop Provider may impose certain rules on Access Network Providers, for instance about emitted power and spectrum of the signal (spectral policing). Examples of Loop providers are the owner of the telephony cables who puts restrictions on the numbers of different DSL systems are allowed in his network or the government who issues licences for the use of the ether by wireless access technologies.

1.2.7 Network Service Provider (NSP)

The Network Service Provider allows Customers to be connected to the Internet backbone or a corporate network. For that, the NSP has SLAs with the Packager of the Customer. The NSP arranges the IP addresses that Customers use to connect with the NSPs network. In the situation that an actor fulfils the NSP role and also has contracts with one or more other actors who fulfil the ASP role, according to the business role model shown in Figure 2 from the Packager/Customer point of view that actor can be considered as an ASP as well.

In the rest of this document the NSP role will be considered as special kind of ASP role and, therefore, will not explicitly be mentioned anymore.

1.2.8 Application Service Provider (ASP)

The Application Service Providers manages services on top of the transport layers. Examples of such services are voice services, a (managed) firewall, video services etc. To enable services the Application Service Provider may distribute software that has to be installed on the CPE in the home.

An Application Provider may connect his network directly with the Connectivity Providers network (in that case the ASP has a business relationship with the Packager) or he may offer his service via the Internet. In the last situation it will be very hard to give any guarantees regarding the QoS.

In case an actor who fulfils the ASP role has a direct business relationship with the Customer, for instance because he sends a bill to his Customers, that actor partly fulfils the Packager role as well.

Finally, a particular example of an ASP service could be the delivery and management of a service platform (e.g. an OSGi service platform) running on the CPE (Residential Gateway). On top of the service platform new applications can be easily installed and started from the network. Third party application providers may deliver the applications.

1.2.9 Content Provider

Content Providers make their content, e.g. movies or music, available to Application Service Providers. The ASP makes an end user service with this content by means of a middleware platform which enables the Customer to listen to/watch the content from his end-user-device.

Often a Content Provider will have very stringent conditions regarding the security (possibility to make illegal copies of the content or consume the content without having paid for it) before an Application Provider may use his content.

2 REFERENCE APPLICATIONS

2.1 Overview & Drivers

The end-user demand for network capacity from business and other organizations was expected to grow through 2003 and beyond about 20 – 40 percent. Nowadays, this forecast must be updated. Actually, the rapid widespread adoption of distributed business applications by many enterprise segments is increasing the need for affordable, reliable and scalable high-bandwidth data networking.

The overall bandwidth demand growth is primarily driven by increasing business needs for branch telecommuter virtual private networks or local area network interconnection, high-speed intranet or extranet access and storage connectivity for business continuity and disaster recovery.

Another major driver for network capacity is the increased demand of enterprise connectivity solutions, which can extend the reach and improve the performance of storage applications such as server consolidation, disk mirroring and remote disk backups.

The fundamental drivers for traffic and capacity demand growth remain strong into the future as is evident from the following points summarizing expectations in the services market:

- Sustained growth in Internet users with broadband (xDSL and Cable Modem) subscribers showing strong gains. Optical networks are needed to reliably transport this traffic from copper aggregation sites across metropolitan and wide area networks.
- Expected adoption and growth of 3G wireless data services will require increased networking capacity for backhauling traffic to mobile switching centres and also across the core networks interconnecting these centres. Similarly, the high growth and popularity of Wi-Fi LAN deployments in business and home environments is expected to drive significant and sustained service traffic demand growth.
- B2C and B2B e-commerce is becoming a larger part of mainstream retail and business transactions.
- An increased interest in and demand for secure and protected business continuity and disaster recovery capabilities. Indeed, some of this demand is spurred by legislation to protect public information records.
- The network storage systems market is expected to grow to around $25 billion in 2005. These network storage systems need carrier grade storage connectivity between data centres.

It is possible to say that “broadband is an accelerator of economic development”. This is because there are significant economic benefits to using broadband technologies for many applications. With broadband access, worker productivity increases, jobs are created and wages grow. As broadband penetration rates grow, there will be a resulting demand for computer and home networking equipment, as well as wireless handheld devices and other equipment that facilitates broadband use.

Because the demand for technological progress is constantly growing, localities that are planning to upgrade their current telecommunications infrastructure should consider the future needs of their citizens when examining the most appropriate systems to install. With the advent of broadband technologies, myriad applications become possible or are enhanced beyond their current capabilities with dial-up Internet access. Some of the applications include:

- Internet access

- IP Telephony
- Video conferencing
- Web-based conferencing
- Content Storage Applications
- Video on Demand
- Broadcast TV (SDTV + HDTV)
- Telemedicine
- Teleworking
- E-Government
- E-Learning
- E-Commerce
- Entertainment

A sort classification of the most relevant applications attending to diverse parameters, mainly bandwidth usage and traffic attributes (real time/no real time) can be established. However, "MA1.2_Application_requirements_table" (included in Milestone A1.2) includes a more exhaustive classification.

Attending to the parameters previously mentioned, we could point out the following groups:

- No real-time & low-bandwidth
- No real-time & high-bandwidth
- Real-time & low-bandwidth
- Real-time & high-bandwidth

There is to remark that almost all the traditional applications of the Internet (such as e-mail or web navigation) fits in the first category.

Although this is not an exhaustive list, these applications are some of the most important for broadband use. The next sections describe some of these broadband applications and provide forecasts of use and growth.

2.2 Tariff models

The charging, billing and accounting schemes used in telecommunications and data networks have been quite simple until now. Users have been mainly billed with a flat rate, based on their subscription and/or the duration of their connection, for either making phone calls or accessing the Internet. Although the technology of these networks is quite different, users are mainly getting the same quality for the services they use. More specifically, telecommunication networks provide the same quality for any user call, while in the best effort environment of the Internet all users are treated equally when accessing an IP service. These schemes are expected to be altered soon as a consequence from the convergence of these two worlds.

Moreover, the introduction of new schemes for QoS provisioning, that aim to support real time services in a quality acceptable by the users, make a newer billing policy necessary. The deployment of such schemes signals the differentiation among users as well as the service flows and packets exchanged through the network. As mentioned before, this differentiation creates the need for new mechanisms that will collect all information concerning chargeable events and after the appropriate processing will impose flexible billing schemes on the users. We should note that the records, containing all information related to the chargeable events, should pose adequate granularity to deploy advanced charging schemes such as content-based and location-based charging.

2.2.1 Billing system framework

From capturing the usage to creating a bill to be sent to a customer, a billing system goes through processes, which can be modelled by a layering framework as shown in Figure 3.

The “Metering Layer” tracks and records usage of resources by observing the traffic flows. The metering policy, used for configuring the metering layer, specifies the attributes of the traffic flows to be observed.

The “Collecting Layer” accesses data provided by metering entities as well as collecting charged related events and forward them for further processing to accounting layer. This layer can collect information from multiple meters, as for multicast and distribute to home domains, as for user roaming. For this reason, the efforts in standardizing data exchange format and protocol at this layer will be beneficial especially for interconnection issues. The metrics from where to collect the data, the type of data and the frequency in collecting them are defined by the accounting policy.

The “Accounting Layer” consolidates the collected information from the collecting layer either within the same provider domain or from other provider domains and creates network accounting data sets or records which are passed to the charging layer for the assignment of prices.

The “Charging Layer” derives session charges for the accounting records based on service specific charging and pricing schemes, which are specified by the charging policy.

The “Billing Layer” collects the charging information for a customer over a time period, e.g. one month, and includes subscription charges and possible discounts into a bill. Billing policy can be used to specify the bill details.

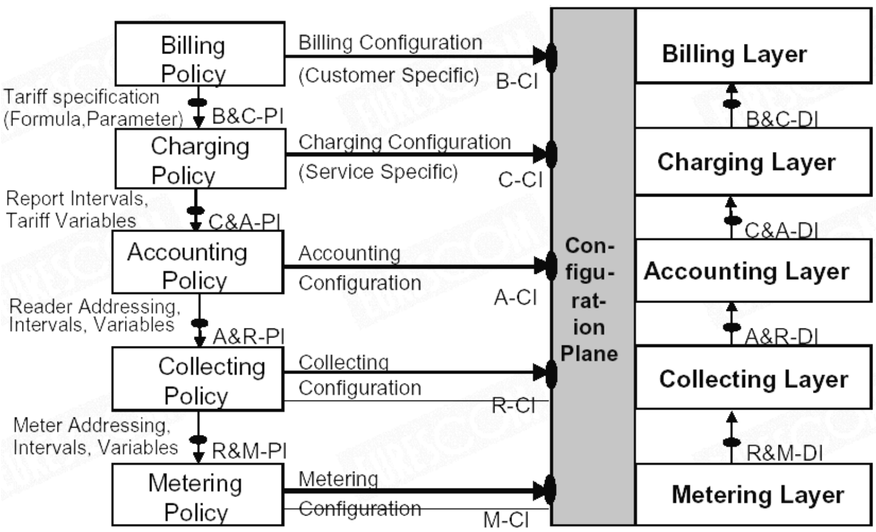


Figure 3. Billing System Framework

Hence, a charging scheme will be an algorithm for calculating the charge for some network service. A user's charge will be calculated based on the accounting data that contains information regarding the resource consumption for that user, and prices from tariff tables published by the provider.

Notwithstanding, for every charging scheme, the parameters used to calculate the final charge will be basically three:

- **Access charge**: It measures among others the cost for connecting to a given network, the maintenance costs and the operative costs for the network.
- **Usage charge**: It measures among others the cost for a given connection. It is closely related to the type of signalling used. It will count up the resources used, the bandwidth needed, the duration and the number of bits transferred.
- **Service charge**: It measures among others the application provided, for instance, it will be different for a videoconference call and for an IP telephone call. It will take into account congestion, QoS and value-added schemes.

2.2.2 Pricing schemes

As seen before, several variables, such as the call duration, the data volume, the reserved bandwidth, the distance between the transference ends, the provision of individual QoS guarantees, the degree of network efficiency or the price plan, are going to take part into the charging scheme. Thus, according to the variable that is taken into account, it is possible to distinguish among different charging schemes as shown in Figure 4.

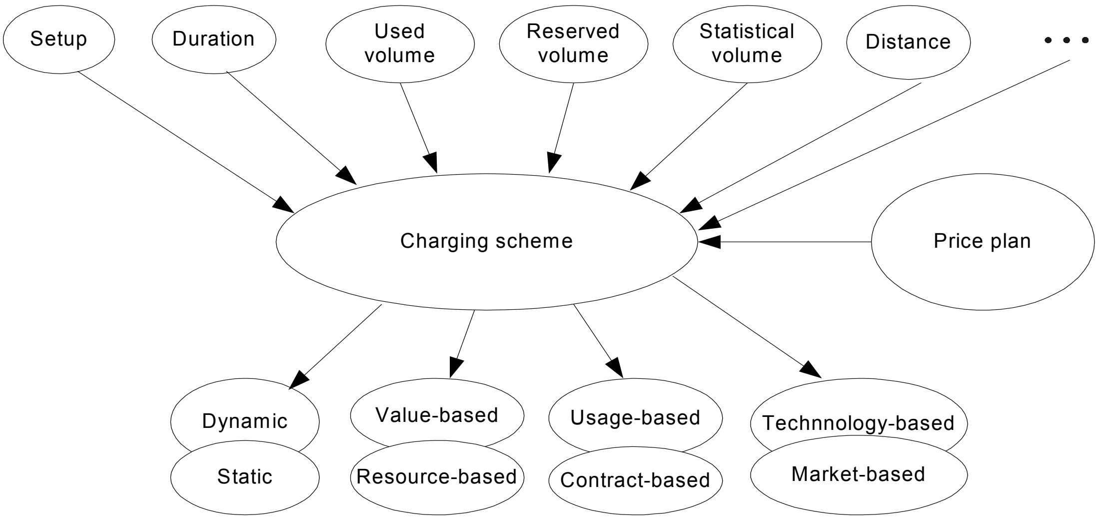


Figure 4. Charging scheme

Therefore, several Pricing schemes could be pointed out. They will depend on the parameters that are evaluated by the service provider. A first approach may be:

- **Static Pricing Policy**: Charging is independent of the network use.
  - Advantage: Easy and cheap implementation.
  - Disadvantage: The user QoS is not taken into account.
- **Dynamic Pricing Policy**: The final charge will be based on the traffic flow, the network congestion, the QoS received, etc.

- Advantage: The user has a detailed bill.
- Disadvantage: It may be difficult to understand for the customer and to implement by the operator.

This approach is very simplified. So, experts have made up another different pricing scheme:

- **Volume-Based Pricing**: It is related to the amount of data transferred or transmitted/received. It can be based on bytes, packets, connections and so on.

  The following types can be distinguished:

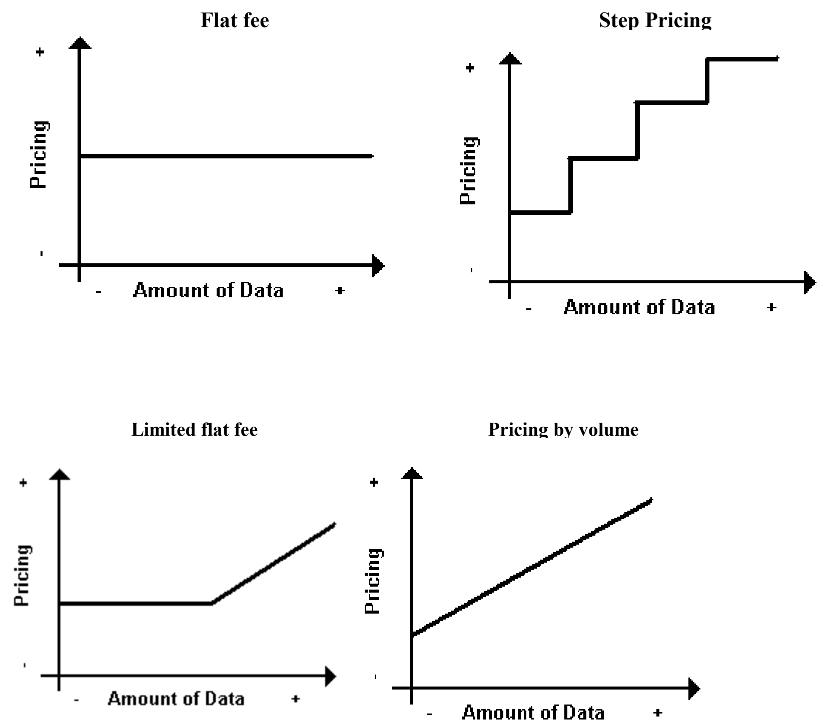


Figure 5. Volume based pricing strategies

  - Advantage: It provides means to regulate the total traffic volume and has no cost for establishment.
  - Drawback: It will be more expensive to download a web site with music and videos than another that is plain. Another big problem is the retransmission of packets that are lost or with errors. This will mean more to pay for the same service.

- **Content-based Pricing**: It is based on the content and type of the data transmitted (images, music, text,…). It is quite feasible in a closed network but it results difficult (almost impossible) to implement in a global network such as Internet. Another problem is the lack of a standard. This may cause confusion among users and added value costs for operators.
- **Flat-rate Pricing**: A given fee will be charged to the user after a given period of time (monthly, quarterly, etc.).
  - Advantage: Easy to be understood by the user. It is simple and liked by many users. It simplifies a lot billing tasks to the service provider.

- Drawback: It may be inefficient for the provider. So, it can be merged with techniques that establish a maximum use. If the user goes beyond that limit, an additional fee will be charged. Another problem is that it does not guarantee any QoS scheme.

➢ **Paris Metro Pricing (PMP):** It divides the network in a set of logical sub-networks with different prices. Each sub-network provides only best-effort services. The most expensive ones will have less congestion than the cheapest.
  - Advantage: The provider is able to make a more efficient use of his network and he can provide different QoS types.
  - Drawback: It may present some difficulties to be understood by the user. In addition, there is high billing complexity (How many service classes are optimal? How to price each sub-network? Inter-operability between different ISPs and how to split revenues among them?).

➢ **Priority Pricing**: This kind of pricing model will guarantee a better QoS. Each packet is marked with a given priority level. So, when the network is congested, the packets are thrown away according to their priority level.
  - Advantage: The provider is able to make a more efficient use of his network and he can provide different QoS types. Congestion can be prevented with appropriate pricing.
  - Drawback: QoS is improved but it is not guaranteed. It may present some difficulties to be understood by the user.

➢ **Smart-Market Pricing**: Users will select resources by adding a packet header. The network gateway will evaluate each packet and will send it according to its header.
  - Advantage: The provider is able to make a more efficient use of his network and he can provide different QoS types.
  - Drawback: It may present some difficulties to be understood by the user.

➢ **Proportional Fairness Pricing**: It tries to incorporate fairness into resource allocation. Every customer is allocated some bandwidth proportional to his willingness to pay. Model assumes a single path for each user, and then maximizes the sum of utility of all users while respecting capacity constraints.
  - Advantage: The provider is able to make a more efficient use of his network and he can provide different QoS types.
  - Disadvantage: It is not useful for some applications. It may present some difficulties to be understood by the user and to be implemented by the provider.

➢ **Edge Pricing**: The congestion along the path between emitter and receiver will be calculated and users will be charged according to that congestion level in a given period of time.
  - Advantage: The provider is able to make a more efficient use of his network and he is able to avoid hard congestion risks.
  - Drawback: It is quite complicated. Utility functions are hard to know, and change over short time intervals. It also may present some difficulties to be understood by the user and to be implemented by the provider.

- **Expected Capacity Pricing**: Users will specify the expected usage of the network and they will be charged on this specification, rather than actual usage. This pricing model was introduced for long-term contracts.
    - Advantage: In order to create the bill, policies are created instead of using difficult measures.
    - Drawback: It may be inefficient for the user because he normally pays more that he is actually using. Another problem is that this policy does not guarantee any QoS scheme.
- **Responsive Pricing**: It is a very dynamic methodology. It is based on congestion control. Prices will rise as congestion increases and prices will decrease as congestion eases.
    - Advantage: This scheme reduces or eliminates packet drops
    - Disadvantage: it improves, but does not guarantee, QoS. It is difficult to be understood by the end user and to be implemented by the provider.
- **Effective Bandwidth Pricing**: Effective bandwidth is the required bandwidth of a session. For a "real-time" session, it is the peak bandwidth. But, for a non-real-time session with unlimited buffering, it is the mean bandwidth. Users will establish mean and peak bandwidth desired use (traffic profile) during CAC and provider will charge according to those wishes.
    - Advantage: Users can change their traffic profile whenever they want to. Charges are based on time and volume, so it is easy to be understood by users.
    - Drawback: it improves, but does not guarantee, QoS. Users should be able to understand traffic bandwidth features of their networks before contracting a provider.
- **Location based Pricing**: Pricing rates are based on the user location. This scheme is extremely related with the nomadic concept. Thus, when a user is near home, it will be easier for the provider to supply the agreed bit-rate. But, if the user is at the airport, in a car or in a department store, more has to be paid for the same bit-rate.
    - Advantage: The provider will get more benefits when he is supplying nomadic applications.
    - Drawback: It is difficult to provide and to manage this kind of pricing scheme. It needs additional technology, such as GIS, and it also needs additional information about the user location. Easy to be understood by the user.

2.2.3 Conclusions

The following table has been included as a summary:

Table 1 – Summary

	Volume based	Content based	Flat	PMP	Priority	Smart Market	Proportional Fairness	Edge Pricing	Expected Capacity	Responsive	Effective Bandwidth	Location

Compliance		VN	IP	IP, VN	IP		ATM /IP	ATM/ RSVP	ATM/ RSVP	ATM ,VN	ATM	
Billing Measurement	Yes	Yes	No	No	Yes	Yes	No	Yes Local	No	Yes	Yes Local	Yes
Congestion Control, Traffic Manag.	No	No	No	Yes Rel	Yes Rel	Yes Rel	Yes	Yes CAC	Yes CAC	Yes	Yes CAC	Yes
Individual QoS	No	No	No	No	No	Yes	No	Yes	Yes	Part	Yes	No
Network efficiency	Low	Low	Low	Var	High	High	High	High	High	High	High	High
Economic efficiency	Var	High	Low	Var	High	High	High	Var	Var	High	High	High
Social Fairness	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes Rel	Yes	Yes	Yes Rel
Time Frame	Short	Long	Long	Long	Med	Med	Short	Med/ Long	Med/ Long	Short	Short	Med/ Long
Static-Dynamic	Dyn	Dyn	Stat	Stat	Dyn	Dyn	Stat	Dyn	Stat	Dyn	Dyn	Dyn

There have been presented two different classifications for pricing schemes, however, they are not the only ones. Next figure represents a complementary option of the given classifications. It is easy to notice that there are some joining points among them (see Figure 6).

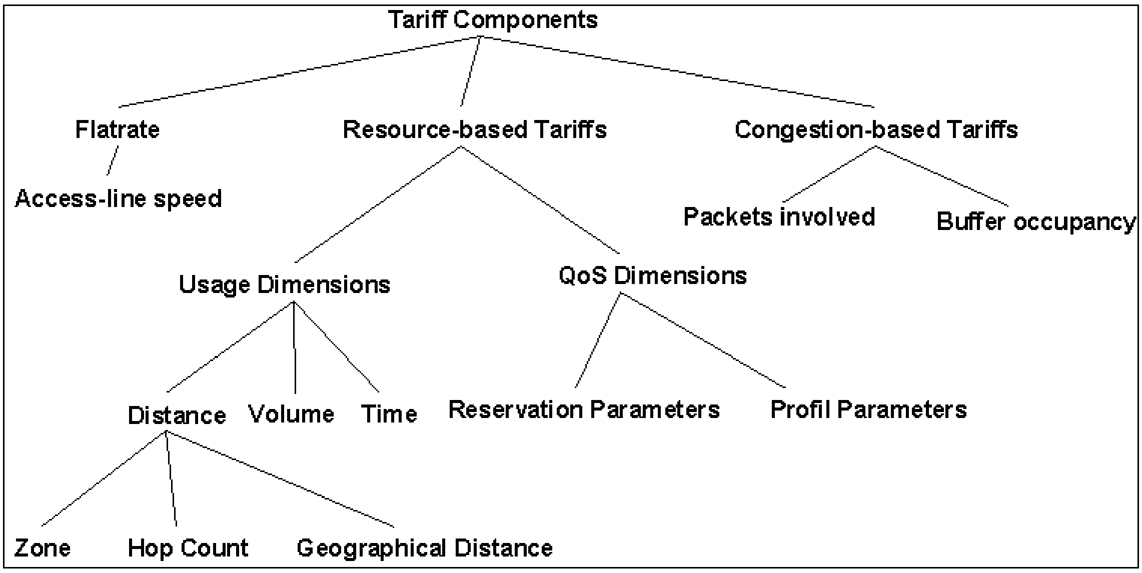


Figure 6. Tariff components partition

So, the need for charging and accounting may be summarize in the following points:

- Control resource usage and reservation in multi-service networks.
- Give incentives to use only required resources.
- Prevent waste of bandwidth.
- Provide signals for capacity planning.
- Maximize profit.
- Minimize total delay and costs.
- Get billing fairness.
- Avoid congestion.

Finally, Accounting has to be flexible, standardized, easy to be measured and easy to be understood by the user (4). It should have a high correlation to the resource usage. The right metric will also depend on the kind of user, that is, an enterprise or a residential user. So, the metric must be simple, fair and compatible with the wishes of the given user.

2.3 Brief description of reference applications

2.3.1 Non real time & low bandwidth applications(NRT&LoBw)

Internet access is becoming more familiar through the last few years. In the early days of the IT era, there were a lot of constraints due to the low-bandwidth approach. This implied that former applications had to fit those restrictive bandwidth constraints. Applications such as web surfing, p2p or e-learning were aimed to work properly in a narrowband environment. Nevertheless, as time goes by, new and enhanced products have emerged. Broadband access has appeared and not only have the newer broadband applications taken advantage of it, but also the low-bandwidth ones.

The emerging of broadband access and the new affordable access tariffs has promoted the new technology adoption by the customers. Newer (high bandwidth) and former (low bandwidth) applications benefit from this new access type. For instance, thanks to broadband access people can download web sites faster. This will be a value-added for customers and they will appreciate it.

Broadband access is used as a generic term to describe a range of technologies and services that provide consumers with “always-on” high-speed data connections. Main broadband products, available to both retail and wholesale customers, are:

- ADSL → technology for transmitting digital information at a high bandwidth over existing copper telephone lines. ADSL is asymmetric and it uses most of the channel to transmit downstream to the user;
- Hybrid fibre/coaxial (HFC) cable → high-speed Internet access delivered via a cable modem;
- 1-Way satellite → allows customers to download from the Internet at high speeds via satellite using their standard telephone service as the ‘uplink’;
- 2-Way satellite → a service providing both uplink and downlink via satellite, avoiding the requirement for dial-up connection via a phone line; and

Broadband access is becoming the new revolution in the European IT Community. The European Commission has published a communication confirming a huge growth in European broadband take-up, and outlining Member States' national strategies for furthering the spread of broadband. The number of people and businesses accessing the Internet at high speed grew by more than 80 per cent in 2003, making broadband take-up faster in the EU than in the US. So, the momentum needs to be maintained, particularly by ensuring competitive markets and the right regulatory conditions for investment.'

Policy makers are very aware of the potential that broadband offers small and medium sized enterprises (SMEs), offering them the chance to boost both their productivity and innovation levels. In addition, the development of broadband has revolutionized healthcare, medicine, administration and education. It may enable real time collaboration between different organizations and professionals, and makes applications such as teleconsultations and telemonitoring a possibility.

Therefore, although simple and plain narrowband connectivity is possible and is still used in European countries, analysts can forecast a gradual movement towards broadband services where both low and high bandwidth applications can be used.

2.3.2 Real time & low bandwidth applications (RT&LoBw)

People are currently integrating their work with the world-wide-web. All aspects of the presentations (midi music, morphing faces, text-to-speech) have been tested as applications which run (transparently to the calling modules) as either local or remote applications, where remote applications are established through the Web. As long as high bandwidth networks are only reachable for a certain groups, consumers are looking for the higher quality within lower bandwidth for their applications.

Over the years we have consistently operated under the constraints imposed by using a low-bandwidth approach, supported by inexpensive hardware. Because of this we are able to speculate on the very real possibility of constructing real-time, truly multimodal, interactive Internet applications that operate at a social level.

As the objective of this deliverable is not to make a detailed forecast of all possible applications to be delivered by the MUSE platform, a representative application for each category has been selected. For RT&LoBw applications IP telephony has been chosen as it can have certain importance in the IT business in the short and mid term. Broadcast audio or live gaming could also be another representative application.

IP telephony, also known as Voice over Internet Protocol (VoIP), is a technology that allows making telephone calls by using an Internet connection instead of a common phone line.

Originally, VoIP and other voice over packet networks were expected to transform telecommunications sector. VoIP provides a competitive threat to the providers of traditional telephone services that, at the very least, will stimulate improvements in cost and function throughout the industry.

An integrated infrastructure that supports all forms of communication would allow more standardization and reduce the total equipment cost. The sharing of equipment and operations costs across both data and voice users would also improve network efficiency since excess bandwidth on one network could be used by the other, and thereby, creating economies of scale for voice (especially given the rapid growth in data traffic).

However, lack of high quality services and infrastructure costs have inhibited, till now, the success of these technologies.

Demonstrable benefits to end-users are also needed if VoIP is going to be a long-term success.

Internet telephony is attracting more and more users because it offers tremendous cost savings relative to the PSTN. Today flat rate long distance pricing is available with the Internet and can result in considerable savings for both voice and facsimile. Users can bypass long-distance carriers, including their per-minute usage rates, and run their voice traffic over the Internet for a flat monthly Internet-access fee.

Even though basic telephony and facsimile are the initial applications for VoIP, the latter could be applied to almost any voice communications requirement, ranging from a simple inter-office intercom to complex multi-point teleconferencing/shared screen environments.

2.3.3 Real time & high bandwidth applications(RT&HiBw)

A real time application with high bandwidth constraints is a service which guarantees that no latency input is longer than a specified maximum and where the user needs to send a big amount of data on average. Not only must the statistical average latency be less than the specified maximum, but the worst case latency must also meet this requirement for strict real time operation. To calculate a worst case latency, the absolute slowest path from the input to the system through the hardware and software must be added together. This means that software conditions must be examined for the entire logical path through the software. Generally the "specified maximum" is dictated by the maximum delay that can be tolerated by the user. Often, high bandwidth and low latency go hand in hand because expectations of QoS in a system extend to both responsiveness and capacity.

Thence, the term real time refers to services or applications whose ability to process data and commands is not only fast enough so as to seem instantaneous (relative to users or systems that rely on it) but who can handle as much data or as many requests as the users and systems are expected to provide.

Besides, interactivity is commonly implicit in real-time applications. As described in MA1.2, interactivity means that there is some dialogue between end users/systems or between end user/system and the network.

Undoubtedly, today applications are increasing their bandwidth requirements. However, the current Internet cannot yet support the full potential demand for real-time services. High-bandwidth services using real-time protocols, such as video, can potentially seriously degrade the QoS of other network services. Thus, operators should take appropriate precautions to limit accidental bandwidth usage. Application documentation should clearly outline the limitations and possible operational impact of high-bandwidth real-time services on the Internet and other network services.

Thus, the main requirements among others for high bandwidth and real-time applications are the following ones:

- Reduced collaborative interaction time between distributed users or processes, that is, low network latency.
- Consistent temporal delivery of data, that is, low network jitter.
- Distributed interaction and visualization of large data sets (what happens if multiple parties want to interact with the data at the same time?), this will be translated to high bandwidth requirements.
- In addition, some applications may ask for more network security, such as banker's order.
- And finally, nomadic networking may also imply newer and more restrictive constraints to our network.

All those requirements as well as the application under consideration should be taken into account when selecting the appropriate pricing scheme.

Multi-participant multimedia conferences (web-based conferences) and Video on Demand (VoD) are going to be described as representative applications but there are another ones that could fit into requirements for high bandwidth and real time systems, for instance as shown in MA1.1, interactive gaming, high speed internet, tele-working, tele-medicine, storage of continuous data, interactive distributed simulation or interactive control and measurement applications.

“Web conferencing applications” allow groups to meet online, enabling collaboration between dispersed teams. It allows audio conferencing using IP networks with optional features like whiteboards. So, by using web conferencing, groups can potentially see, hear, text chat, present and share information in a collaborative manner.

Organizations will be motivated to adopt Web conferencing when they realize of its ability to minimize the time and resources associated with corporate travel. Enterprise organizations in the verticals of government, health care, financial services and high-tech have been the major users of Web conferencing. Smaller companies have been slower to recognize the benefits but will play a good chance in the future growth of the market.

“Video on Demand” stands for video that consumers can instantly access whenever they want to. It gives the ability to the customer to have access to his own content from a library data base, and to play that content in an interactive way (play, pause, fast forward, etc).

There is to remark that, although Video on Demand applications must reproduce the timing relationship that existed at the origin end, they cannot be considered as strict real time applications because interactivity is not necessary (and therefore, delay requirements could be less severe than in video conferencing). However, and as has been stated, there is a timing relationship between source and sink, so that this kind of application may fit better as a real time application than as a non real time one.

The Personal Video Recorder (PVR) and the Internet Protocol Television (IPTV) are two different applications that could be considered as drivers for VoD. Both of them will help us to understand how VoD is evolving nowadays and why broadband services are needed in order to facilitate content exchange.

PVR is a very important driver to success in the video distribution market. Also know as Digital Video Recorder (DVR), it is a device that is similar to a VCR but records television data in digital format (storing data in a hard drive) as opposed to the VCR’s analog format. PVRs will be as accessible to the market as VCRs are today because they are friendly for the user. PVRs have all of the same functionality of VCRs (recording, playback, etc) plus the ability to instantly jump to any part of the program without having to rewind or fast-forward the data stream. So, PVR offers consumers more control on his TV set-top box. Also, new features such as the possibility of skipping advertisements easily or pausing live TV will be feasible thanks to PVR adoption. Or even, PVR may provide newer, faster and easier features to exchange personal videos among non-expert people. Obviously, there is no point to mention that broadband services will enhance PVR facilities in order to achieve the best performance of this new service. Two common American PVR companies today are TiVo and ReplayTV. For instance, the new TiVo technology will allow users to download movies and music from the Internet to the hard drive on their video recorder. Although the current TiVo service allows users to watch broadcast, cable or satellite programs at any time, the new technology will make it possible for them to mix content from the Internet with those programs.

Companies are also planning the development of newer end-to-end IPTV delivery solutions. These solutions intend to help cable and telecommunications operators in order to offer improved next-generation TV services over existing broadband networks. The IPTV solution will provide "next-generation" features such as instant channel changing, multimedia programming guides with integrated video, and multiple picture-in-picture capability on standard TV sets. High-definition television, next-generation digital video recording (DVR), and video on demand (VoD) functionality also will be supported. The IPTV system will also include robust digital rights management (DRM) technology to provide the high levels of security for video assets and TV services which operators and content providers are demanding.

2.3.4 Non real time & high bandwidth applications(NRT&HiBw)

Contrary to the previous categories, these applications consume high bandwidth, but do not impose real-time constraints, or at least not very stringent ones. For example, *content-storage applications*, or *near video-on-demand*, where video streaming can be downloaded into a local buffer, and displayed as “real-time” after an appropriate delay.

Furthermore, some of these applications may ask for security or nomadic networking. This will also imply new features and more restrictive constraints to the network.

An appropriate pricing scheme should be chosen bearing in mind the requirement constraints and the application under consideration.

Content Storage Applications will be the representative applications but, as mentioned before, they are not the only ones. There are also other applications that could fit into requirements for high bandwidth and non real time systems. For instance, the MA1.1 did already include the Personal Video Recorders (PVRs), High Speed Internet (HSI) or Home Multiplay.

“Content Storage applications” are addressed to save, preserve and retrieve sensible data. The value of storage lies in the intellectual property contained therein.

Major business processes of any enterprise, such as Enterprise Resource Planning (ERP), Supply Chain Management, Customer Relationship Management (CRM), Knowledge Management, and Inventory Management, depend strongly on the quality and quantity of the stored data. The amount of corporate data is presumed to double every 6 months.

Besides, the secure storage and distribution of digital media content is a core infrastructure service in digital production and broadcast.

Growing needs in both enterprise data storage and data protection have accelerated the enterprise storage spending worldwide and the development of storage technologies, so that storage is changing, from being directly attached to servers (Direct Attached Storage - DAS), toward networked solutions that, being based in known computing technologies that enhance performance, efficiency, and reliability, offer consolidation of storage resources and meet the growing needs to share information, both inside and outside the company, while maintaining uptime.

Networked storage can be implemented either resting on a Local Area Network (LAN) in the form of Network Attached Storage (NAS) or in a dedicated network, also known as Storage Area Network (SAN).

Both SAN and NAS offer compelling solutions with different advantages. For example, a SAN scenario provides fast transmission over dedicated networks and support data transfer over longer distances than those achieved by Ethernet, which is used by NAS. In the NAS scenario the storage traffic shares bandwidth with other traffic over LAN, but NAS products are designed to be easy to install and operate.

The decision to deploy one versus the other should be based upon business considerations such as costs, distance requirements, number of users, and staff skill sets. However, integration and consolidation of network attached storage (NAS) with storage area networks (SANs) is also a potential happening.

Companies will be encouraged to rent SAN services when they evaluate the new opportunities that those applications provide. Bigger organizations will be the first niche market for Storage services. Nevertheless, smaller companies will also have a slower introduction within this market as they discover its new market chances.

2.4 Applications potentiality in the market: Tariff forecast

2.4.1 No real time & low bandwidth applications (NRT&LoBw)

According to the Commission of the European Communities, deployment and take-up of broadband are increasing at a fast pace in the European Union. At the end of 2003 there were 22.8 million connections, an increase of almost 100% over one year (see Figure 7). All Member States are experiencing a rapid expansion of the broadband market, but disparities are still significant. The average EU penetration rate (defined as a percentage of the number of subscribers over total population) increased from less than 3,4% at the end of 2002 to 6% at the end of 2003.

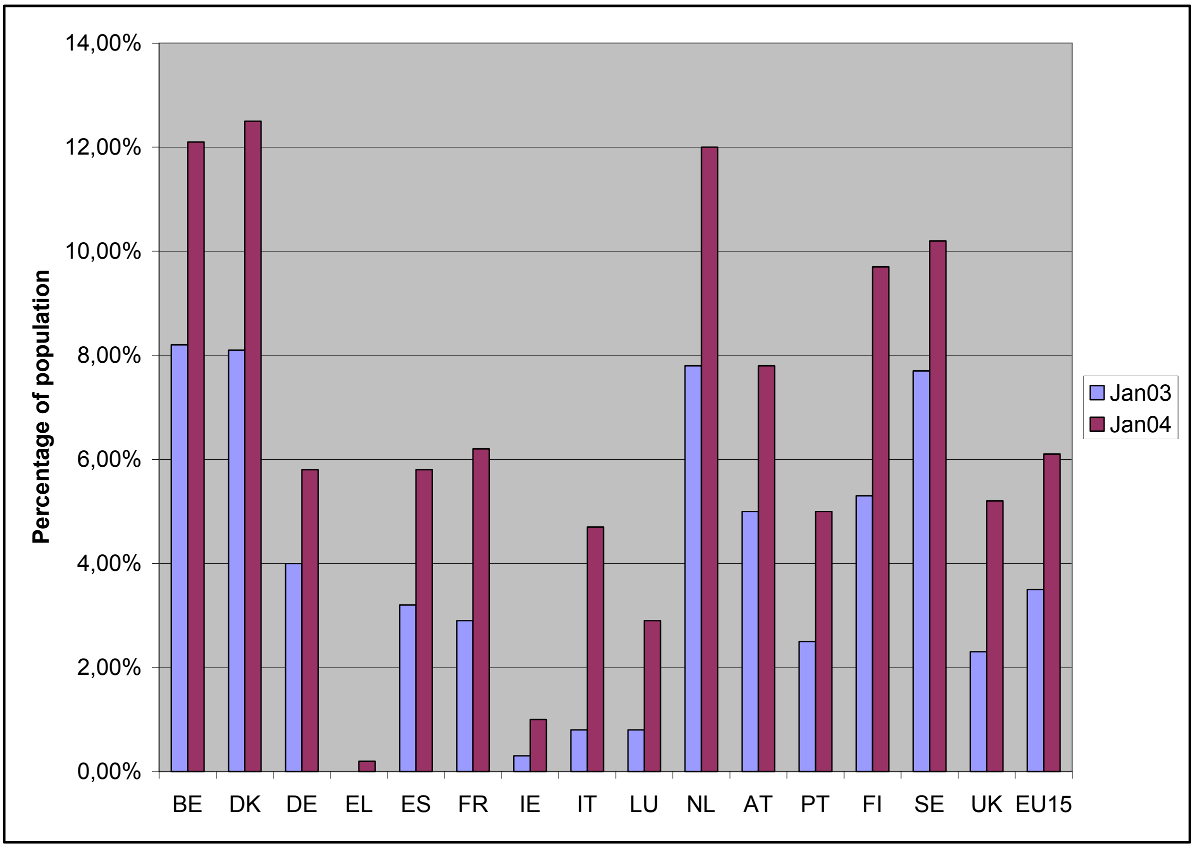


Figure 7. Broadband penetration

Nevertheless, we can distinguish between some groups in society more used to work with new technologies and others that are usually more excluded. The most vulnerable groups in society, such as the unemployed, the elderly or the disabled, are overly represented among the digitally excluded. The focus of policy should be to promote digital inclusion in order to alleviate social exclusion.

We are still at an early stage in the integration of the Internet into the economy and society, and many of its wider economic and social impacts are yet to be felt. We cannot say categorically that there is a positive correlation between digital inclusion and social inclusion or that the cost of not being online is further social exclusion. Yet, the Internet does seem to create new opportunities to improve individual life chances and alleviate social exclusion. In a recent survey, 93 per cent of Internet users in Europe said that people who do not access the Internet are missing an opportunity. In Figure 8, the Internet use per groups in Europe can be seen.

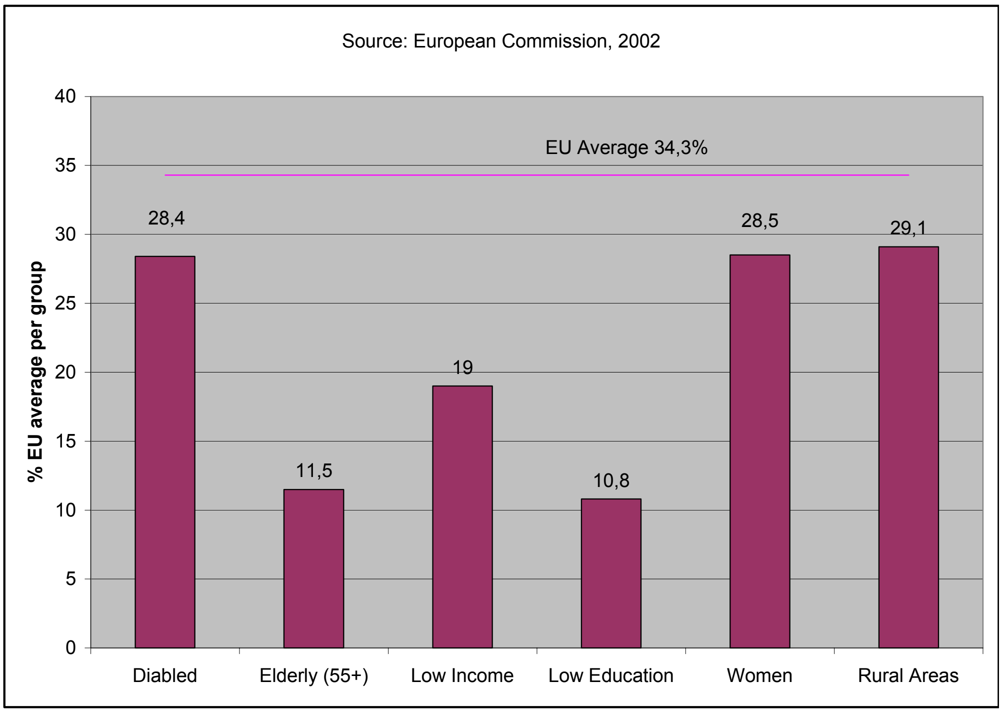


Figure 8. Internet usage per socio-economic contour

Significant proportions of citizens are not online and have no interest in being online. Figure 9 below indicates the percentage of individuals surveyed from different countries that see no benefit in the Internet.

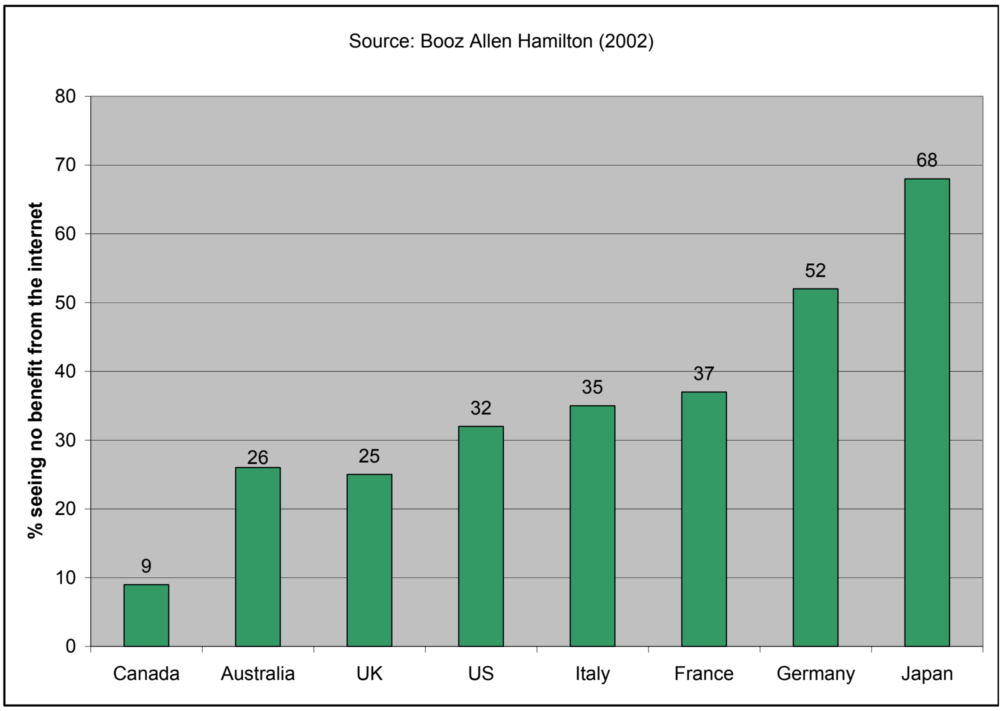


Figure 9. Perceived benefit of the Internet

Significant resistance to the Internet should come as no surprise. Business has set out a clear vision of what it perceives to be the benefits of the Internet, for instance, cheaper holidays, instant access to your savings, celebrity updates and online chat. But, in many cases, government has failed to take a leadership role and explain the wider, social benefits of being online in order to make the internet relevant to disadvantaged groups.

As can be seen in Figure 10 and because of the wide reach of PSTN, recent broadband deployment is being mainly driven by DSL technologies. So far, in January 2004, DSL represented 74% of total connections and cable reached 22%. Other technology platforms seem to be still in earlier stages with few subscribers but with an increasing subscriber's base.

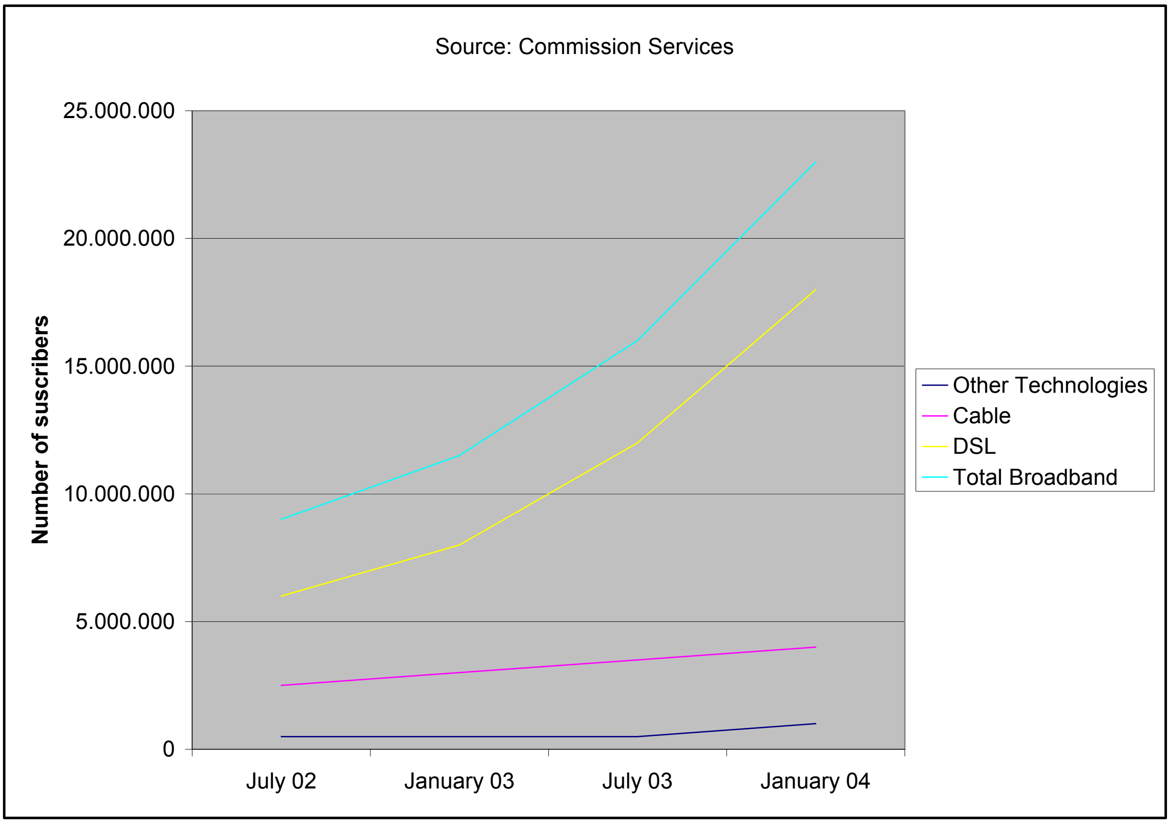


Figure 10. Subscribers per technology

According to this, for EMEA (Europe, Middle East and Africa), it is forecasted a growth in the revenues for broadband and digital TV while decreasing the switched access revenues components (see Figure 11). Additionally, it can also be said that Broadband penetration will overtake digital TV penetration during the 2002-2008 forecast period.

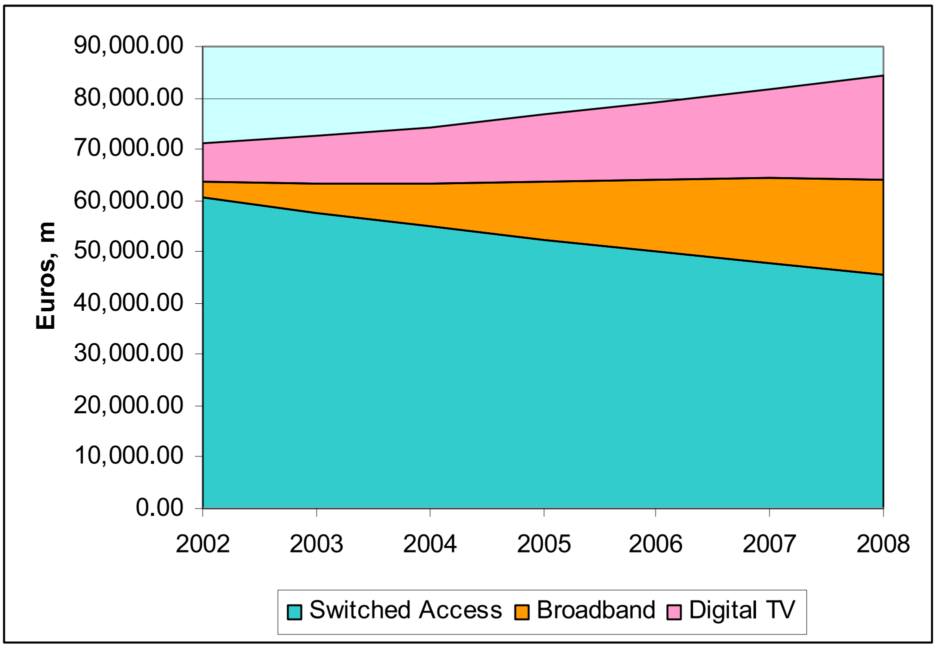


Figure 11. Revenues forecast for EMEA countries

Also, according to a recent forecast (February 2004) from the Yankee Group, the basic ARPU (Average Revenue Per User) for residential DSL will decline during the next years from 30-to-35 euros in 2003 to approximately 20 in 2008 (see Figure 12).

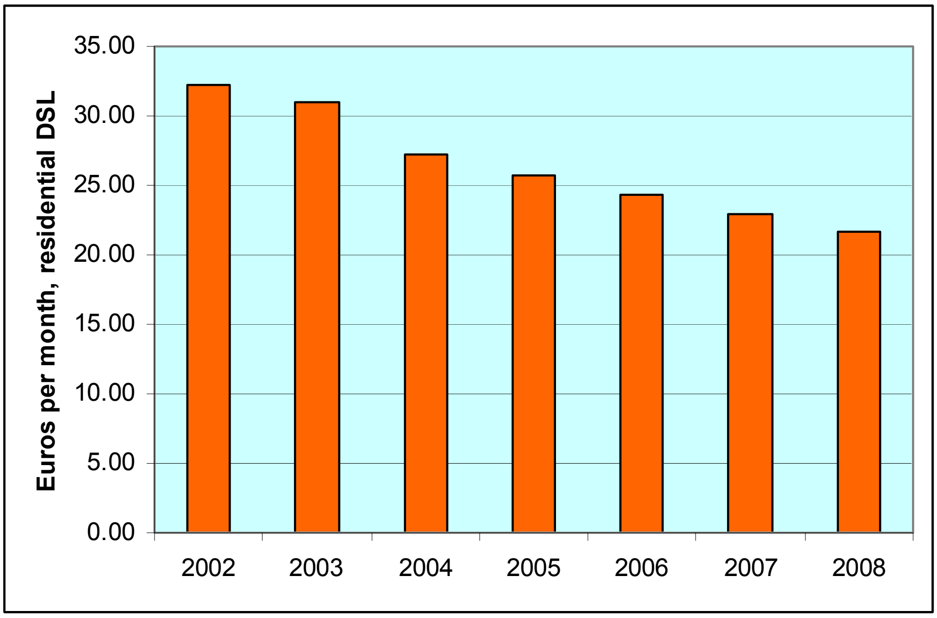


Figure 12. Evolution of ARPU for residential DSL (source: Yankee Group, 2004)

Pricing packages are a key determinant of time spent online. In countries with metered access charges, the average person spends 5 to 9 hours a month online. This compares with 32 hours in the USA and 20 hours in New Zealand where a large proportion of users have flat rate access (in 2001).

Awareness that the bill is mounting with every minute spent online is a strong deterrent to greater usage. Over 90 per cent of users in the UK on metered narrowband access said that the cost of calls put them off spending more time online. Following the introduction of flat rate narrowband access in the US in 1996, internet usage tripled from 8 hours a month to 22 hours a month in 1998, and 32 hours in 2004. UK's introduction of Off Peak anytime where users were charged 1p per minute throughout the day saw a surge in usage at peak times as users were no longer afraid of running up a huge bill. Following the introduction of flat rate narrow band access in the UK in September 2000, usage among members increased from just over 10 minutes a day in 1999 to over an hour a day.

Figure 13 shows prices charged by incumbents in the Member States for different speeds in February 2004. Prices relate to monthly residential un-metered offers, and do not consider the initial fixed cost of the modem.

Prices are similar across countries at low speeds, while variations are more pronounced at higher performances. Tests on the correlation between broadband penetration and prices confirm that prices are significant determinants of broadband take-up at all performance levels, except for speeds above 2Mb/s. In this category, the availability of high-speed seems to be attractive in itself, independent of price.

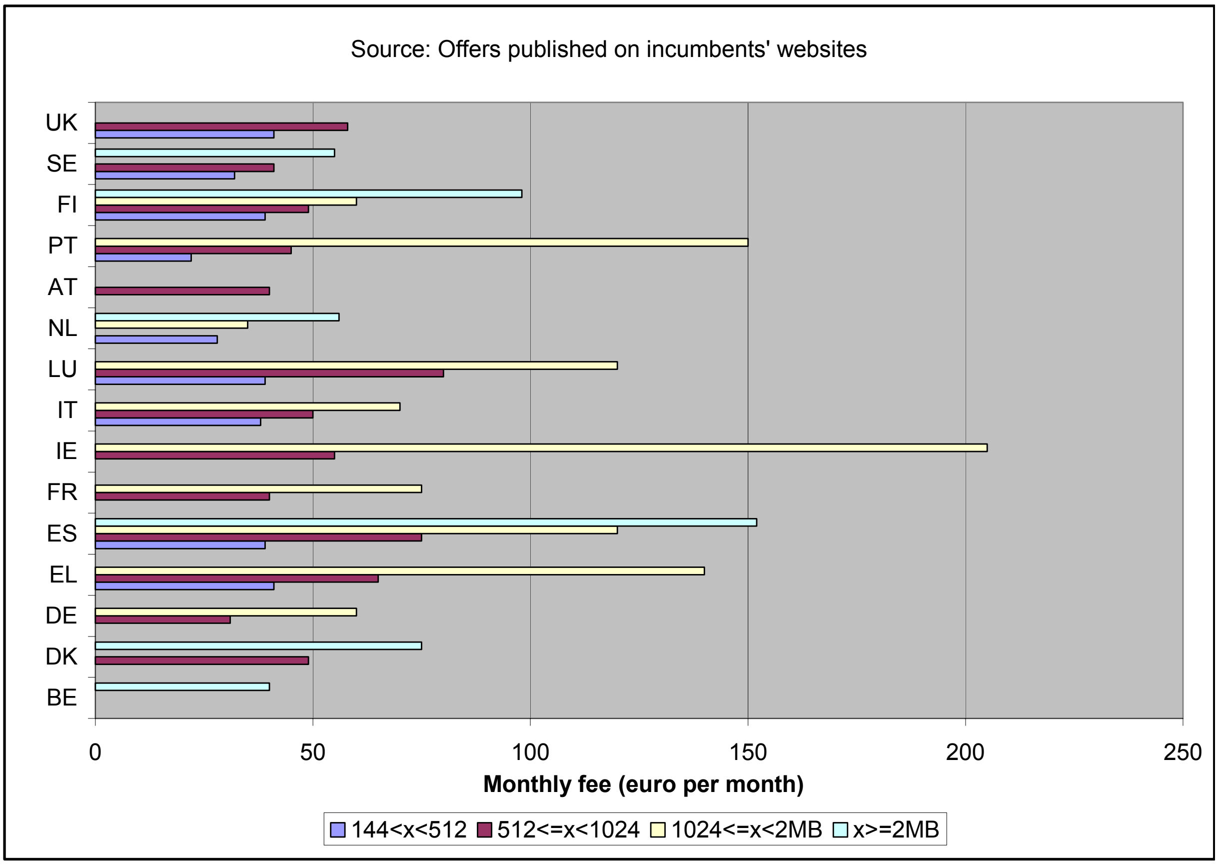


Figure 13. Incumbents' prices for un-metered residential DSL (February 2004)

2.4.1.1 Tariff forecast conclusion

Historically, telecommunications prices have been based on distance rather than the nature of an application. Theoretically, the further a signal had to travel, the higher the switching and transmission costs. That not only gave a basis for a pricing structure but also provided the means for cross-subsidizing telephony service. Notwithstanding, after the IP revolution, this kind of policy has become difficult to apply to some services such as web browsing or p2p applications because people are not aware of the actual location of the content. So, location based pricing results costly and ineffective for NRT & LoBw applications because of the former habits in IP networks.

For non real time and low bandwidth applications, flat rate tariff models seem to be the suitable ones because those applications will be available not only for big enterprises but also for residential users. Providers are revising tariffs periodically at very economic, competitive and attractive prices to attract customers. So, tariffs should be low enough to stimulate the demand.

Besides, those flat rates might be modulated, for instance, with access type constraints, with time intervals or with a mixture of both:

- Access type based on available bandwidth: Undoubtedly, a user with a 56k connectivity will pay less than a user with a 256k connectivity. Therefore, providers should establish a chart table with the tariffs according to the bandwidth access type.

- Time intervals: Providers may establish a flat rate tariff between a given time interval, for instance, from 6pm to 6am. Those who want to use the network out from the given interval will be charged with more expensive fees. This pricing type may be appropriate to launch offers specialized to some groups of people, such as the residential users.

Nevertheless, regarding pricing policies, there is not a right criterion for selecting a given one; it will depend among others on the service provider, the final customers and the business evolution at a given moment.

2.4.2 Real time & low bandwidth applications(RT&LoBw)

2.4.2.1 IP telephony

After years of development, VoIP is finally ready for prime time. Adoption will be strong over the next years and will bring dramatic changes in the telecom landscape.

Consumers are looking at VoIP service as a replacement for their primary phone line, not as a secondary backup. VoIP could also serve as a lure for new subscribers, given the strong interest among narrowband households.

The success of cellular phone service proved in its origins that consumers would accept unreliable and less-than-perfect voice services (if they are intelligible and cheap enough), and with IP traffic entering nearly half the businesses and households in the U.S., the opportunity is just too large to be ignored. Nevertheless, voice traffic falls into the intolerant real-time category. Humans are intolerant of speech delays of more than about 200 milliseconds (ms). The dilemma is that while elastic applications can tolerate a fair amount of delay, they usually try to consume every bit of network capacity they can. In contrast, voice applications need only small amounts of the network, but that amount has to be available immediately. By the time a network is congested, it is too late to be adding intolerant real-time applications to the mix. So, a given network availability must be assured.

In order to make an efficient management of the voice network, an important baseline numbers must be taken into account by the service provider. For instance:

- Average number of calls per hour.
- When busy times occur in a day, month and year.
- The peak number of calls in the busy hour.
- Average duration of the calls.
- Acceptable ratio of blocked to completed calls.

By this way, VoIP has been suddenly the most written about, talked about and hyped subject in the telecommunications world. VoIP equipment accounted for as much as 20% of total enterprise voice equipment in 2003. International long-distance on VoIP is growing at about 35%. However, it still is not selling much. That is to say, there really is not a strong telecom market impact yet. The enterprise sales tend to be replacement sales, not incremental.

The forecast market penetration of network VoIP also suggests major changes in the telecom network. These changes include a move towards IP networks and a move to replace the classical “class-5” central offices with soft switches. However, most importantly, network VoIP is a significant challenge to the core business and it could foreshadow a major reordering of the industry.

As said before, “class 5” replacement provides the big obstacle for end-to-end packet voice. As things stand, incumbents run expensive parallel voice and data networks, relying heavily on single-service switching and routing equipment located at the edge of the network. To make the dream of multiservice access switches (MSS) economically viable, incumbents must attract a critical mass of residential and SME broadband customers. Therefore, VoIP's success, measured as a share of end-to-end fixed-voice traffic, is also closely linked to what happens with broadband access.

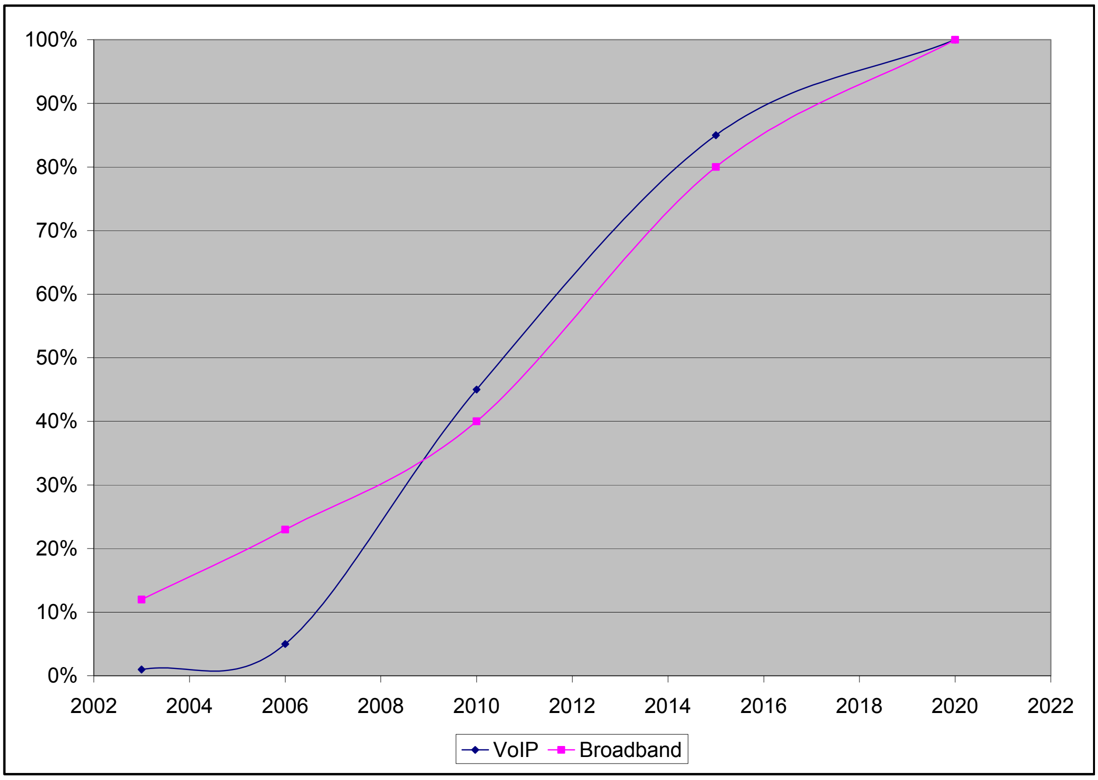


Figure 14. Market penetration

Forecasting network VoIP is extremely difficult because it is really in its infancy, and because there are a number of “side issues” that could have major positive of negative impacts. In spite of the difficulty, some forecasts suggest that by 2010 network VoIP will be serving nearly 20,000,000 households, about 25% of the global potential market. The market value analysis will suggest that the network VoIP market can near a value of one billion dollars by 2010. Top priorities will include a limited “class 5” replacement in 2007 (as VoIP attains carrier-grade) alongside hosted VoIP solutions for enterprise and SME users. It is also expected that 45% of European fixed-voice traffic be VoIP end to end by 2010, and that VoIP capture 85% of the European fixed-voice market by 2015.

The longer term benefits are expected to be derived from multimedia and multiservice applications. For example, Internet commerce solutions can combine web-surfing with a voice call button (also know as click-to-dial) that allows to make an immediate call to a given call centre from the PC.

Needless to say, voice is an integral part of conferencing systems that may also include shared screens, white boarding, etc. Therefore, combining voice and data features into new broadband applications will provide the greatest returns over the longer term.

2.4.2.2 Tariff forecast conclusion

Voice over IP (VoIP), also called Internet telephony or IP telephony, will include some advantages over traditional telephony:

- Lower costs per call, especially for long distance calls.
- Lower infrastructure costs: once IP infrastructure is installed, no or little additional telephony infrastructure is needed. Note that voice over IP traffic does not necessarily have to travel over the public Internet: it may also be deployed on private IP networks.
- The need for only a multiservice network, reducing the different deployed infrastructure into a common one.
- Better use of the available bandwidth.

Nowadays, IP telephony is commonly used to route traffic that may be originated from and terminated at conventional PSTN telephones.

VoIP is now widely deployed by carriers, especially for international telephone calls. Most commonly, users are completely unaware that their international telephone call is being routed over IP infrastructure for most of its distance, instead of entirely over the PSTN infrastructure.

In function of the call interconnection with the PSTN necessities, the use of VoIP services can be split in two:

- On the one hand, a lot of providers are offering VoIP solutions to intercommunicate computers along the IP network. VoIP is also used by large companies to eliminate call charges between their offices, by using their data network to carry inter-office calls. Charges for this kind of use are extremely difficult for the service provider. So, pricing schemes might be integrated within the flat rate of NRT&LoBw applications.
- On the other hand, there are companies that offer a gateway to the PSTN from any VoIP phone; this is a value-added service to the conventional PSTN. One can simply dial a conventional telephone number and the telephone call will be routed over his Internet connection to the company that operates the gateway, which will issue the respective bill instead of the local phone company. ENUM makes it possible to dial traditional E.164 phone numbers, being connected entirely over the Internet if the other party also uses ENUM, so one does not incur any expenses other than the internet connection fees. They may also use VoIP to reduce the costs of calls outside the company, by carrying them to the nearest point on their network before handing them off to the PSTN.

In this specific case, VoIP pricing should be very competitive, especially for International calling. VoIP networks can interconnect to facilitate terminations abroad and such calls will be handled either by the provider or by a carrier partner of the provider. For example, these applications might have a similar pricing scheme to the PSTN one, that is, a fixed fee which includes the cost of the first minute followed by a time fee charged for the remainder of the call including any onward connected call time. Furthermore, location schemes might be applied to the customers. Nevertheless, fees might be reduced because of the advantages of VoIP.

Besides, because IP does not by default provide any mechanism to ensure that data packets are delivered in sequential order, or provide any Quality of Service guarantees, implementations of VoIP face problems dealing with latency and possible data integrity problems. So, providers might also charge additional fees for QoS guarantees.

Concluding, there is a clear trend towards flat rate pricing that is only slowed down by the current PSTN interconnection fees. As, IP networks evolve and replace traditional PSTN infrastructure, this trend will continue. However, new value added services such as mobility and nomadism may alter this trend. The final balance is difficult to foresee, but it seems that at least, in the medium term, pricing policy could still be based on duration and location features.

2.4.3 Real time & High bandwidth applications(RT&HiBw)

2.4.3.1 Web-based conferencing

While the traditional audio conferencing market continues to grow, emerging Web-based solutions are likely to have a profound impact on the long-term future of the conferencing market. Voice-over-Internet systems, for example, may be less expensive than traditional solutions and attract cost-conscious customers. Similarly, increasing use of Web-based conferencing software in business communications may diminish the urgent need for traditional audio and document conferencing services. Combining voice and data features (video, shared screens, white boarding's, etc.) into new applications will provide the greatest returns over the longer term.

Enduring complexities of group document conferencing systems and lack of end-user awareness of the benefits of conferencing continue to restrict the potential customer base. Consequently, manufacturers and developers will have to invest significant resources in educating customers about the technology to elevate demand. Understanding end-user issues will be crucial in this customer-driven marketplace.

Companies are beginning to realize that the business trips (sleeping on hard hotel mattresses, cramming into coach class, attending endless presentations and lectures) might be simplified and substituted by staying in the office, just using a web-based conferencing. According to the National Business Travel Association, corporate travel budgets have been cut 20 percent on average in the past year, and 75 percent of these companies have turned to conferencing to control costs and conduct business more efficiently. So, web-based conferencing seems to become a good chance to the IT market. It seems that if used right, it can save time and money. There is no better example than in the business environment, where conferencing has quickly become ingrained into traditional ways of conducting business as companies recognize its many benefits. For instance, in a business meeting not only incur "hard costs", like airline travel, food and lodging, but also "soft costs", such as the salaries of meeting attendees.

Studies (5) have demonstrated that, for example, if four of the participants from different locations travel by plane to attend to a meeting, its cost adds up to almost 5,200€; if the group meets by videoconferencing, meeting costs drop to about 1,700€. By contrast, the same meeting conducted by audio conference costs under 700€. So, the time and cost savings from those trips can become quite significant when applied to an entire company.

Clearly the infiltration of conferencing in the business arena is not a new trend, but it is a growing one. As one of the world's fastest-growing providers of conferencing services, *MCI WorldCom* saw a dramatic growth in its conferencing services in 1999. Overall audio conferencing call volume grew 40 percent; videoconferencing grew 35 percent; and Net conferencing volume grew an astounding 216 percent.

Studies (6) show that the Web-based conferencing market has been stronger in North America than in the rest of the world (See Figure 15). The revenue will grow from $620 million in 2003 to $2.4 billion in 2008. Because the technology infrastructure in Europe and the Asia-Pacific is not as robust, at the present time, the Web conferencing market is smaller, only $130 million revenue in 2003. As the worldwide economy recovers, Web conferencing outside North America will grow even faster to nearly $950 million in 2008. Actually, conferencing services have grown more than 50% per year during the past three years and will continue to show strong growth in the coming five years. The main reason for this growth will be the enhanced technology, broad bandwidth and ongoing reduction in travel.

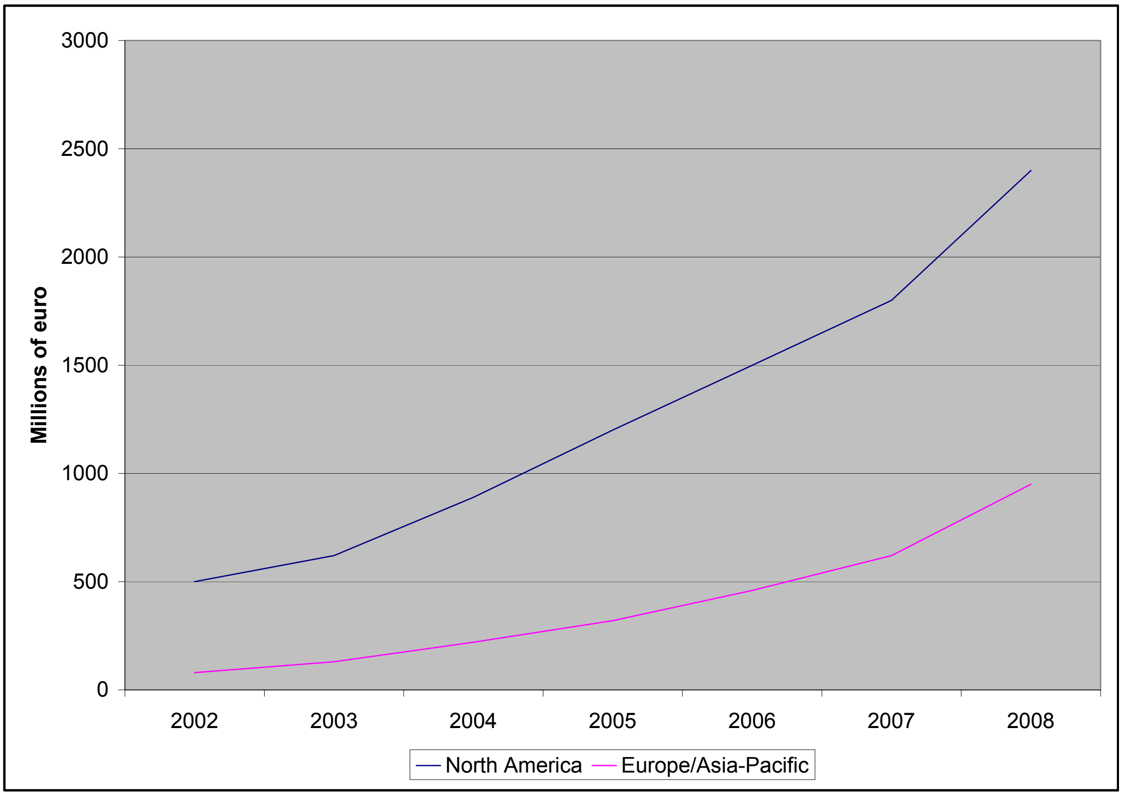


Figure 15. Web-Based Conferencing market forecast

Thus, emerging Web-based solutions are having a profound impact on the long-term future of the conferencing market. Internet-based conferencing is significantly less expensive than traditional solutions, attracting the cost-conscious customers who before were hesitant to jump into the market.

Therefore, in a few years time, web-based conferencing will be as common as audio conferencing is today. People who have data, applications or other information to present, share or even work on together will have access to web conferencing sessions from their desktops. The user interface will be intuitive enough to allow the user to use a whiteboard, demonstrate a process by sharing an application, add a video clip, etc, without outside assistance.

Products, services and applications will continue evolving as businesses embrace Internet-based meetings and broadband access is enhanced. Notwithstanding, this kind of application perhaps seems to be more oriented to business enterprise market. Normally, residential users prefer cheapest solutions and VoIP may satisfy their necessities. So, only if this application could become cheap enough, new markets could be opened to its introduction.

2.4.3.2 Video on Demand (VoD)

Video on Demand applications are revolutionizing the service provider business models and the TV user experience. On demand TV will allow users to watch whatever content they want, whenever they want.

Video-on-demand (VoD) technologies will allow consumers to access thousands of hours of content instantly whilst PVRs provide a truly personalized TV experience. Lured by the prospect of a mass-market audience and ever-improving technology, content publishers are ramping up their efforts to penetrate this market. Similarly, broadcasters are eager to gain a head start in providing their customers with on-demand and interactive services to drive the uptake of digital services and tap new revenue streams.

VoD is a good example which reflects a crucial issue, the convergence between broadcast and telecommunication. All kinds of data, including text, voice, graphics and moving images are converged in the form of digital data and transmitted on a demand basis. Conventional broadcasting stations are now changing into the storage that contains a huge capacity of digital database so a variety of programs can be transmitted to subscribers, responding to their needs.

Hence, interactivity will be the other significant characteristic of the new communication way that best matches the concept of VOD. Individuals seek information or television programs, then information supplier respond to that. It could be possible that individuals create the contents of program according to their tastes.

Ideally, in order that individual homes are delivered TV programs on a demand basis, a broadcasting station should work like a personal computer at home, which could be accessed at the user's convenient time nation-wide or world-wide. So, it should function as a video juke box. First of all, TV programs will be changed into the digitalized format and stored in the hard disk of the computer in a broadcasting station. The problem is the fact that video data requires huge amount of storage capacity, even when compressed. And, it costs a lot to equip such a high capacity of server. Secondly, a new switching technology is required to send the desired program by a particular route to the subscriber. Unlike traditional circuit switched network (point-to-point), a program should be accessed by multiple user simultaneously (packet switching), then changed back to analogue video signal again, which is very costly.

According to some studies (7), VoD has attracted by now over 18 million households in US. However, VoD has yet to take root in Europe, as it hasn't been able to rise above trials and a handful of money-losing rollouts. After consulting several sources (TV operators, ADSL operators, technology vendors, etc), the study (7) shows that VoD costs a fortune to build, and a fortune to deliver, although the economics of running the service have improved (for example, the video server cost per stream has dropped by 225% over the past two years). Actually, the total cost per stream remains high at about $600 per stream, as it includes other costs like video compression.

Regardless of delivery mechanism, running costs will remain high, consumer uptake slow, and top content sparse. So, the VoD business model will not improve unless those bottlenecks are erased. However, European VoD consumers are increasing. So key market advances will turn VoD into a viable proposition and they will make VoD applications closer to the customers.

Thus, despite of the high costs of VoD, it actually looks like a winner compared with other similar technologies. According to the current trends foreseen by the analysts, VoD will clearly overwhelm other technologies, such as Interactive TV.

According to (8)(see Figure 16),by 2005, the number of cable VoD households in North America could be 3 times that of Europe and 10 times that of the rest of the world. VoD and PVR will go "hand in glove" in the next generation of on-demand services. Both of these technologies will grow at a CAAG rate of 56% and over 473% annually through 2008, respectively as both are set to grow at about 50% on a CAAG basis through 2008. While the service revenue generated by cable VoD deployments will grow at 56% annually, IP- and broadband-based VoD service revenue will grow at over triple digit rates 100% through 2008.

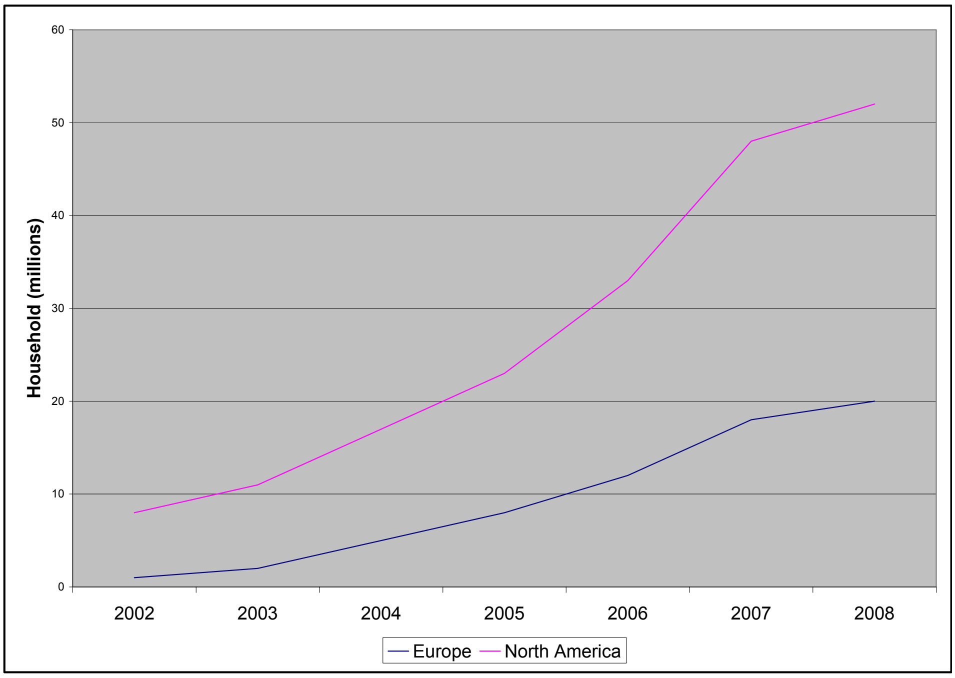


Figure 16. Cable VoD HH Forecast

On the other hand, PVR technology has managed to make a place in the broadcast market. Nowadays, PVRs have started to break through in France and the UK. For instance, *Canal Satellite*'s introduction of *Pilotime*, a high-end set-top box with time-shifting technology, has helped to reach 50,000 subscribers, charging them a €20 monthly subscription and €8 for box rental. *BSkyB*, using a different business model (consumers buy *Sky+*, rather than rent it), cut the price of the box in 2003 to £199 and has seen an increase of about 30,000 subscribers; it has now waived £10 monthly charge to drive further uptake.

According to some researches, the worldwide unit shipments of PVR products grew from 1.5 million in 2002 to 4.6 million in 2003. For the last quarterly of 2004, there are some projects that point that unit shipments will top 11 million. There are two primary reasons for the recent growth of PVR unit shipments:

- The integration of PVR capabilities into DVD players and recorders has been a big success. Demand for these combination DVD-PVR products has proven to be especially strong in Japan, and it is likely that a growing percentage of DVD recorders shipped worldwide over the next few years will incorporate PVR functionality, accounting for almost 80% of total unit shipments in 2004.

- There is also a rising demand from satellite and cable TV operators for PVR-enabled set top boxes. Many pay-TV service providers, especially in North America, where cable TV operators have already installed the products in over half a million households, are rolling out PVR products to increase subscriber revenues and to keep their current customers from defecting to competitive service providers.

These two market drivers will continue to spur growth for PVR products over the next several years, as can be seen in Figure 17.

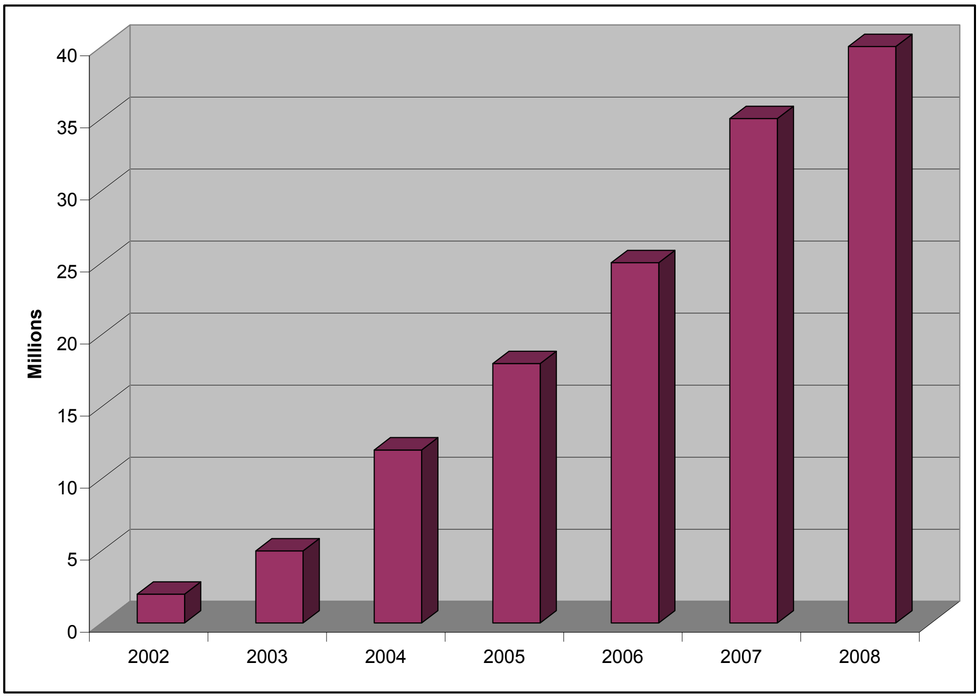


Figure 17. Worldwide Forecast for PVR

Therefore, at a first glance, VoD and PVR seem to be very fruitful business possibilities for a wide range of enterprises as well as for the customers:

- Broadcasters, for instance, should examine the potential suitability of on-demand content offerings and identify successful business models and possible alter-native revenue streams.
- Service providers should examine market segmentation to best position their on-demand TV services.
- Content providers should identify leading on-demand TV service providers in order to assess potential partnerships and alliances. Content providers should also define an appropriate positioning in the value chain and they should consider the impact on existing revenue streams and business models.
- Hardware vendors and consumer electronics manufacturers should quantify the future demand for VoD technologies. They should identify appropriate areas for new product development and try to understand trends affecting market dynamics and its evolution.
- Finally, customers should position themselves and evaluate the benefits of VoD facilities. Having experienced the long history of video and television, people have reached the point at which they expect to watch what they want, at the best time they desire, and VoD will probably satisfy this demand.

To sum up, VoD is being developed under two hypotheses. One is that people enthusiastically want to participate in the interactivity with a television. The other is that people are inherent information seekers. VoD could be considered a good example of a service which reflects a new communication pattern more segmented toward each individual. It is related to activities like seeking information of one's own choices, navigating in the World Wide Web. More educated people and younger generations are more energetic in searching into information database, and possibly prefer interactive television viewing. VoD is driven by the conception that activities such as choosing from a large body of programming offered at a wide range of prices, responding to the program or testing themselves with others, and sometimes creating the program on one's wishes is rewarding to people.

However, it is obvious that people are required of extra efforts for this interactive viewing. Since the television programs are now perceived just like any other commodity or service in the marketplace, viewers have to weigh expected satisfaction against price. Even though the viewer will be aided by new previews or convenient navigation systems which provide a full description of menu, they still work on potentially selecting satisfying programs out of vastly expanded choices. Do people really want to be engaged in such activities after a hard day working? Customers may prefer to spend leisure time in more passive occupation, caught up in the hands of the master television producers. Maybe people do not like being attentive to the program, just because they have chosen it and committed to the cost.

2.4.3.3 *Tariff forecast conclusion*

Both applications presented within this section belong to the real time and high bandwidth applications group. However, while web-based conferencing might be more business market oriented, VoD might be more residential market oriented. Therefore, they should be treated separately when talking about pricing.

On the one hand, operators forecast that web-based conferencing will take the place of audio conferencing and meetings when enterprises realize of its potentialities. Wages and expenditures for business trips might be reduced and substituted by staying in the office. Business models and pricing schemes should be strongly considered by service providers because the success of web-based conferencing applications depends on them. For instance, a Combination Charge Fee might be a suitable option; that is, a fixed fee may be applied as soon as the call is answered as well as a time fee that is applied throughout the call including any onward connected call time.

On the other hand, residential customers are nowadays used to spend some time in the video stores to choose the blockbusters. Surely, VoD will success if it has the appropriate marketing campaign and pricing scheme. Operators should show the benefits of having the possibility of renting videos from home and having complete availability of them (without any queue). Our local video store charges over 4€ for new releases (VHS or DVDs) and requires they be returned in two or even in one day. As customers are tired enough of paying extra fees for delaying the video return, it seems an appropriate time to consider a cheaper and more convenient way to rent a movie.

So, the real problem lies in VoD marketing more than in the price point. Perhaps, service providers should offer free VoD movies periodically to illustrate just how good a bargain below 4€ is for a service that customers may not have yet tried.

Different pricing schemes might be discussed. For instance, operators should distinguish between download rentals, streaming rentals or pay per minute schemes for billing. In addition, the customer may distinguish between different paying diagrams such as the prepaid package or the "buy now, watch now" package.

2.4.4 Non real time & High bandwidth applications (NRT&HiBw)

The information economy that emerged during the past decade produced a new perspective of data and information. Now, the data and the information gathered is regarded as a critical business asset. Indeed, as the marketplace has become global, data stores more often provide the key to an enterprise's competitive edge. Where data was previously considered just a part of an automated application system, it is now referred to as a separate strategic corporate resource.

Heightened dependence on data in the corporate sector has elevated its importance to daily operations and productivity. As a result, a corresponding rising share of Information Technology (IT) budgets is being allocated to data storage, management, and protection. Mass data storage is no longer an afterthought for IT managers. Storage systems and storage technology are critical elements in a company's IT infrastructure.

Many storage experts are of the opinion that the current period of budget tightening and the advent of the networked storage sub-market will strain market growth of proprietary storage vendors, and there could be a shift in the leader board. Indeed, about 30% of corporate data is at present managed by networked storage, and this is expected to grow to 70% by 2006.

An outgrowth of the information economy and its greater dependence on data is a burgeoning need for gathering more data. Customer related data is particularly crucial to preserving sales growth in the fiercely competitive world marketplace. Analysis of all this data, frequently involving data mining, produces even more data that further swells corporate databases. Storage needs are creating new challenges and innovations in the mass storage industry, as well as infusing the market for storage products and services. According to (9), 38% of Global 3,500 firms have completed or are in the process of rolling out a SAN, while another 42% are considering or piloting one.

There will be a rapid pace of technological investment with more and more vendors trying to help customers to protect their technology investments by supporting upgrades, as these will not be willing to make substantial investments for products that can be found obsolete in a year or two. Inter storage solutions data migration will also have to be considered by vendors.

In the mass storage industry, technology advancements have consistently delivered reduced cost per megabyte, increased storage capacity, and improved product performance (faster data access). Historically, the relatively high cost per megabyte for online data storage demanded a conservation approach to buying and utilizing online storage resources. Over the past decade, the cost of storage capacity has plummeted and evaporated that demand restraint in the storage market sectors. It has been replaced by a more liberal policy toward meeting corporate storage needs, and encouraged a relaxed broader view of online data access and storage. This is fuel for a storage capacity boom strengthening and vitalizing the mass storage market.

Different networked storage applications could be based on different storage approaches with different costs and requirements such as remote back-up (vaulting), storage on Demand (SoD) and mirroring (asynchronous and synchronous).

When it comes to storage systems, small enterprises tend to lean towards the least expensive solutions. Studies (10) reveal that investments on IT products and services are growing within U.S. small business. The price cuts in SAN/NAS systems, coupled with enhancements to make the technologies more IP-friendly, were welcomed by the data-intense segment of the small-business market. So, small enterprises are viewing on network storage solutions a new technologic opportunity for their business.

In terms of growth, it is expected that, in short-term, 85% to 90% of enterprises will be using some form of networked storage to take full advantage of this technology.

2.4.4.1 Tariff forecast conclusion

Service providers offer a storage area network (SAN) as a high-speed special-purpose network that interconnects different kinds of data storage devices with associated data servers addressed to a large number of users. Therefore, it seems normal that SAN services will be normally offered to business markets. Tariffs should be studied to fit those markets. Probably, a good pricing scheme might be setting a fixed fee, that is, a charge that is periodically (monthly, quarterly, etc) applied for administrative costs plus a variable fee that is set according to the amount of data that are backed up (similar to the concept of credit interest) or the amount of available capacity that is rented by the customer (similar to the concept of loan interest).

2.5 Major conclusions

Forecasting of penetration and tariff evolution is a quite difficult task mainly because there are present two opposite players.

On the one hand, there is the Telco operator which needs to offer to the customer the proper applications at the proper price.

On the other hand, the customers are the ones who select which will be their reference applications and, depending on their needs, will make ones more relevant than the rest.

Considering these issues, some assumptions can be proposed with regards to the penetration and tariffs. In the following lines are involved all the actors present in the value chain, but for simplifying the discussion, only two of them will be mentioned: the customer and the operator (or service provider).

To determine a clear conclusion about tariff models seems to be a difficult task for operators. There are several variables that should be taken into account in order to create the tariff chart that better fits to a given business model.

Normally, it is easy to distinguish between residential and business markets. While residential users prefer cheapest and easy-understanding solutions, big enterprises do not mind to sign more complex agreements if they can take some benefit. Thus, the first approach should divide operator markets into residential and business environments.

In the past, charging was based in distances constraints, that is, high international and long-distance rates were high enough to keep the cost of local service affordable. But, nowadays, the practical reality is that the regime for pricing bandwidth has assumed the predominance. It is estimated that data traffic has been doubling every year; in the past 20 years, data traffic has increased 1 million times; fax transmissions make up fully half of what is counted as voice traffic; and in a few years, given current trends, 99 percent of all traffic will be carried on IP networks. Therefore, bandwidth will be the second variable to be taken into account by the providers.

Modern societies have become more dependent on the smooth functioning of networks. That is, people like working fast and without problems. Such dependency is, for the most part, invisible. However, it is when these networks fail, become congested, or get disrupted that society learns how much of its welfare rides on so little. A transaction for even a simple item involves a complex communications dialogue that alternates between secure and insecure, priority and non priority, flat rate or usage sensitive, and so on. Hence, it is likely that future-charging mechanisms will need to have knowledge of the application being used. So, both the application use and QoS requirements would be important attributes which also have to be taken into account when thinking about billing.

Having all these variables into account there are different schemes that could be suggested. Nevertheless, the best option seems to be a flat rate (or even modulated by intervals of time), which may provide a basic set of applications.

Following that, most of the users will pay for a "basic" broadband fixed Internet access at a flat rate and with a low cost, that is, the operator fixed cost for providing the service plus a low profit. After the analysis performed, it seems that a monthly rate of, for instance 25-30 Euros, will have good chances of success.

The operator needs to assure their recurrent revenues coming from the monthly fees in order to guarantee their ability to offer the basic broadband access. Therefore, they must achieve a "basic" service penetration as higher as possible. The trends suggest that current recurrent revenues due to the plain old telephony services (more concretely the monthly fee) will be replaced by the "basic" broadband access monthly fee.

The table of Figure 18 shows the evolution and penetration of business revenues in Europe from 2002 to 2007.

Is clear from this table an increase of the Business DSL, IP VPNs and Wide Area Ethernet compensated with a decrease of the leased lines and the switched access.

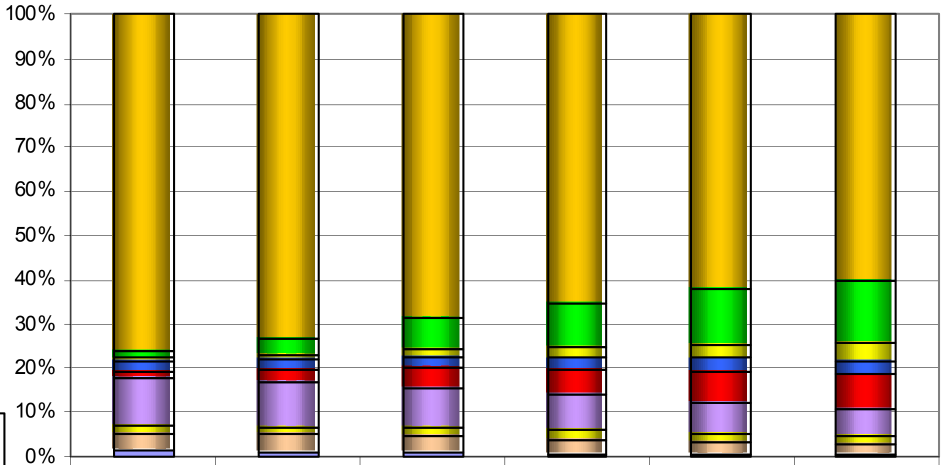
We can see also that Frame Relay services will have a decrease of around 30% wile the X.25 services will decrease about 75%.

As it seems that, initially, it will be difficult to increase the revenues; these should be big enough so that the operator be able to update his network infrastructure.

Finally, revenues of new applications will enter in action, as they will offer to the users a real value added and will allow to the operators to increase their revenues so that the latter will be able to invest into new services and applications innovations.

Perhaps, more complex models (amount of data, time of connectivity, etc) could be delivered to enterprises because there is already a tendency for trying to find the best option which optimises their benefits. In addition, it could be possible to create pricing packages in order to deliver some basic applications to the customers. Or even, to create a prepaid package or card to use different services. The fees for using those services had to be charged to our prepaid card.

Source yankee Group February 2004



Revenues in Euro Millions	2002	2003	2004	2005	2006	2007
Switched access	70,541.3	67,432.7	62,643.8	61,523.0	59,819.9	57,985.4
Business DSL	1,616.2	3,613.9	6,594.2	9,628.8	12,026.2	13,970.8
Wide-Area Ethernet	676.9	1,015.3	1,523.0	2,132.2	2,878.5	3,886.0
Dedicated IP	1,818.4	2,091.2	2,404.9	2,645.4	2,830.6	3,028.7
IP VPNs	1,587.8	2,802.0	4,204.6	5,444.8	6,921.0	7,414.4
Leased Lines	9,834.4	8,960.9	8,154.8	7,433.8	6,778.9	6,013.2
ATM	1,802.5	1,854.7	1,882.8	1,886.2	1,810.6	1,607.7
Frame Relay	3,591.1	3,576.3	3,415.3	3,163.7	2,805.4	2,473.2
X.25	1,168.2	949.8	748.3	566.1	404.4	281.1

Figure 18. Evolution and penetration of business revenues in Europe

It is also remarkable that most of the pricing scenarios operate at the level of national or regional markets. There is no effective global benchmark for comparing bandwidth prices in the same fashion as; for example, crude is invoked in global petroleum markets. In essence, if the Internet is to become the Global Information Infrastructure (GII), it would seem plausible that the price of bandwidth should evolve along lines similar to the prices of other global commodities.

In conclusion, as said before, there seems not to be a unique option when thinking about pricing. The final decision should be taken by the service provider according to his final customers and to his business situation.

3 SOUND BUSINESS MODELS

The success of a business model is related mostly to the degree of satisfaction of the players, which in turn could be reflected by the value, revenue and expansion of the business. So business models are created to satisfy the players by providing a fair sharing in the value chain including providing the maximum value to the customer. Additionally the revenue / value sharing should also be in relation to the costs incurred by the players. These costs are usually the capex (capital investment) costs, the opex (cost of operations) costs and the subscription costs for the customer. These terms and conditions for the different costs in the business models are usually monitored & regulated by the telecom regulating bodies like OPTA in Europe, FCC in USA, etc.

3.1 History

Initially there was only one service provided to the customer, the voice service. During the dawn of the Internet access service, the Internet Service Providers owned and operated their Point of Presence servers connected to the Internet, usually leasing lines from the regional network provider. The customer used the connectivity provided by the network operator (for voice) and dialled into the POP servers. The customer had a business relationship to the ISPs, which was independent of the relationship with the connectivity provider. Later the Internet services were provided free, with revenue sharing between the connectivity provider & the ISP, the revenue being collected from the customer by the connectivity provider for the usage of the telephone line. This has evolved into new business models with the advent of DSL technologies.

3.2 Typical Business Models

Some typical business models are described with the implications on the value chain and value to the customer are described in the following subsections.

3.2.1 Service Provider Focused Model (Wholesale Model)

In this business model, also known as the wholesale business model, the customer has a direct business relationship R1 with the actor B for connectivity and services. The business relationship R1 is typically a subscription contract, which includes the cost & duration of subscription, the services subscribed for and the qualifiers such as QoS, bandwidth, etc. if applicable for the services. Actor B plays the role of the packager and ASP, but for providing connectivity to the customer, actor B has a business relationship R21 with actor C.

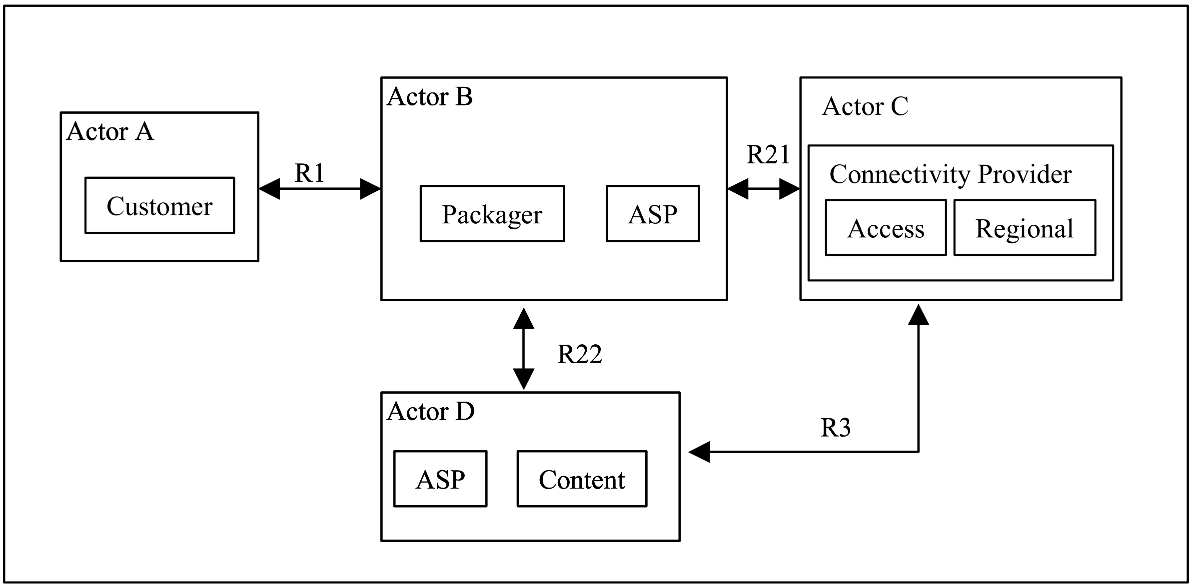


Figure 19. Service Provider Focused Model (Wholesale Model)

The business relationship R21 would typically include terms & conditions for bulk or wholesale purchase of first mile loops, bandwidth & QoS parameters, etc. Actor C plays the role of a connectivity provider, which includes the roles of an access network provider and regional network provider. Actor B may have business relationships R22 with one or more actors D for providing additional services to the end user customer. Actor D plays the roles of ASP and content provider in this example and Actor D has a business relationship R3 with the Actor C for network connectivity.

3.2.1.1 *Business Relationships*

The business relationships in this model are:

1. The business relationship R1 between the customer & actor B (main ASP) for connectivity & the services. This includes the subscription costs (variable, monthly, yearly, etc.) and the service level agreement. The service level agreement includes typically the subscribed services (e.g. Internet access, Video on Demand, etc.), the bandwidth and other qualifiers for these services.
2. The business relationship R21 between the actor B (main ASP) and actor C (connectivity provider), is the wholesale business relationship, where the actor B buys the right to use the connectivity for a large number of customers. This agreement can be restricted to certain regions or applicable to all regions where the connectivity provider is active. The terms & conditions are such that the actor B can add new customers easily; the cost structure could be such that there is an initial cost, fixed cost & variable cost based on number of customers being served. This business relationship is based on the so-called ‘unbundling of local access’ and usually monitored heavily by public regulating bodies.
3. The optional business relationship R22 between actor D (ASP) for additional services with or without content.

3.2.1.2 Cost Model

The capex costs are concentrated in the role of the connectivity provider, actor C in the figure, while the opex costs are distributed between connectivity provider and the service provider(s). The capex & opex costs of the different actors are eventually reflected in the customer subscription as follows:

1. The business relationship R21 includes the part of the capex & opex costs of the actor C (connectivity provider) to the actor B (main ASP) proportional to the number of connections, total bandwidth, QoS, etc.
2. The business relationship R1 includes the costs of the actor B (main ASP) and the costs related to the connectivity provided (proportional to the costs incurred by actor B from actor C).
3. Optionally, business relationship R1 may include costs for any extra services, provided by actor D relative to the costs in business relationship R3.

3.2.1.3 Examples

An example for this business model is Cistron (actor B) and Tiscali or BBNED (actor C) in the Netherlands (http://www.cistron.nl/internetverbinding_dsl_part_adsl.html).

3.2.2 Network Operator Focused Model

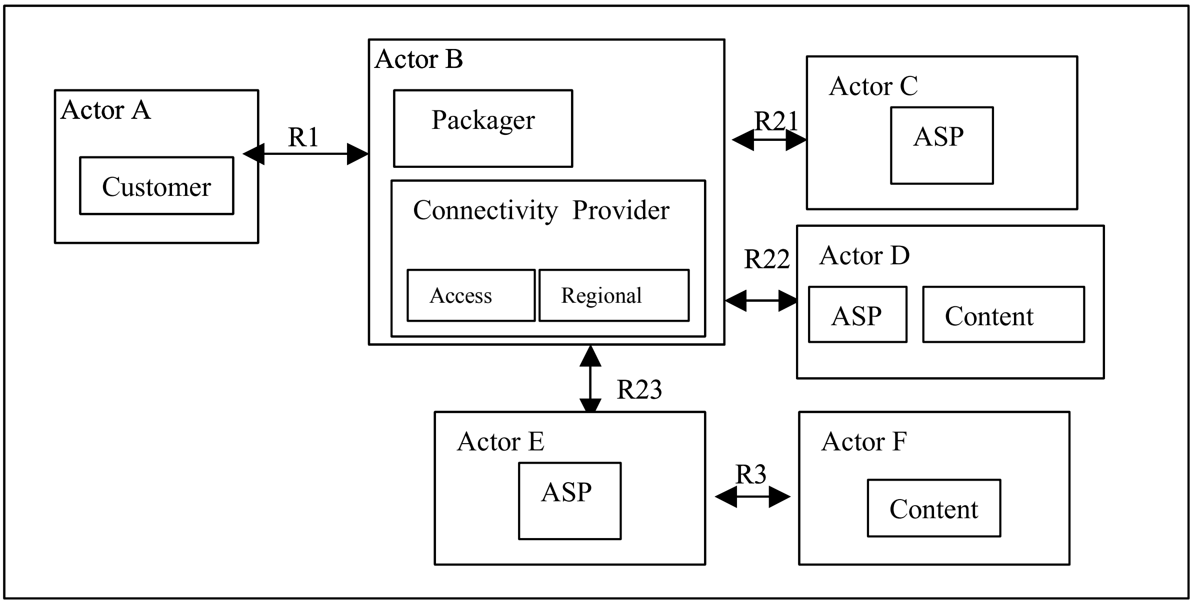


Figure 20. Network Operator Focused Model

In this business model, the customer has a direct business relationship R1, with Actor B for connectivity and services. . The business relationship R1 is typically a subscription contract, which includes the cost & duration of subscription, the services subscribed for and the qualifiers such as QoS, bandwidth, etc. if applicable for the services.

Actor B plays the role of a connectivity provider, which includes the roles of an access network provider, and regional network provider and the packager for the services. Actor B has business relationships R21, R22 & R23 with Actors C, D and E for the services. Actor C plays the role of an ASP, which does not use any content, e.g. video telephony, Internet access, etc. D is an example of an actor who plays the roles of ASP and content provider. Actor E plays the role of an ASP and has a relationship R3 with Actor F who plays the role of a content provider.

3.2.2.1 *Business Relationships*

The business relationships in this business model are:

1. The business relationship between the customer & the connectivity provider (R1) for connectivity & the services. This includes the subscription costs (variable, monthly, yearly, etc.) and the service level agreement. The service level agreement includes typically the subscribed services (e.g. Internet access, Video on Demand, etc.), the bandwidth and other qualifiers for these services.
2. The business relationship (R21, R22, R23) between the connectivity provider and the ASP for a number of services. These services could be Internet access, Video on Demand, Voice on IP, etc. Similar to the wholesale connectivity business relationship, this is a wholesale relationship for the services. The business relationship could include the costs and the service level agreement for the services. The cost structure could be distributed into an initial and recurring fixed & variable costs.
3. In some cases there could be a business relationship between an ASP and a content provider (R3). As an example, an ASP could exist, for the Video on Demand service, which has a business relationship with one of the content owners for the Videos (e.g. media companies like Sony, EMI, Bertelsmann or movie companies like Columbia, MGM, etc.). This business relationship includes the costs for wholesale purchase of videos and could include cost differences based on the time of release of Videos, popularity of Videos, etc.

3.2.2.2 *Cost Model*

The capex & opex costs of the different actors in this business model are eventually reflected in the customer subscription as follows:

1. The business relationships R21, R22 & R23 include the capex & opex costs of the ASP actors C, D & E respectively (The costs of actor F is channelled through R23 (actor E).
2. The business relationship R1 includes the costs of the ASP actors C, D & E and the costs of the connectivity provided.
3. Optionally, business relationship R1 may include costs for any extra services, provided by actor D relative to the costs in business relationship R3.

3.2.2.3 *Examples*

An example for this business model is BT and Yahoo in UK, which is offered as 'BT Yahoo! Broadband' http://www.bt.co.uk/broadband/bb_info.jsp), the customer receives just one bill monthly.

3.2.3 Independent Service Provider Model

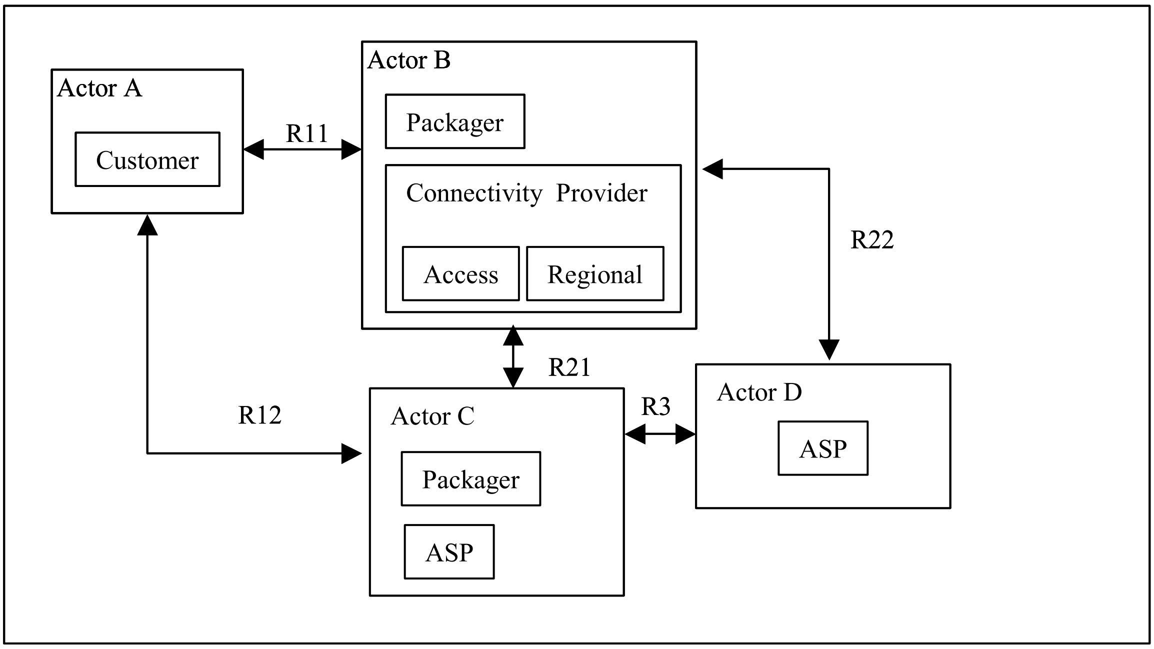


Figure 21. Independent Service Provider Model

In this business model, the customer has 2 business relationship R11 and R12. R1 is the relationship with Actor B for the connectivity and R12 is the relationship with Actor C for the services. Actors B & C have a relationship R21 which will cover the connectivity between their infrastructures. Actor C may have additional relationship such as R3 with other ASPs e.g. actor D. Actor D may have relationship, R22 with the connectivity provider actor B for network connectivity.

3.2.3.1 Business Relationships

The business relationships in this model, which include two major business relationships towards the customer, are:

1. The business relationship between the customer & the connectivity provider (R11) for connectivity. This includes the subscription costs (variable, monthly, yearly, etc.) and the service level agreement. The service level agreement includes typically the upstream & downstream bandwidth and other qualifiers for this bandwidth such as QoS, etc.
2. The business relationship (R12) between the customer & the ASP for one or more services such as Internet access, VoD, etc. This includes the subscription costs for the services and the service level agreement.
3. The business relationship (R21) between the ASP and the connectivity provider for connectivity and co-location.
4. The business relationships (R3) between the ASP, actor C and optional ASPs for providing additional services to the customer.
5. The business relationships (R22) between additional ASPs and connectivity provider if needed.

3.2.3.2 Cost Model

The capex & opex costs of the different actors in this business model are eventually reflected in the customer subscription as follows:

1. The business relationship R11 between the actor B (connectivity provider) and the customer includes the capex and opex costs of the actor B (the connectivity provider).
2. The business relationship R12 includes the capex & opex costs of the actor C (ASP) plus the eventual costs of the actor D (the content provider).

The opex costs of actor C and actor D include the costs of the business relationships R21 and R22 respectively with the actor B (the connectivity provider).

3.2.3.3 Examples

An example of this business model in The Netherlands is KPN (actor B) and Wanadoo (actor C) with the customer receiving two bills monthly respectively to KPN & Wanadoo (http://www.wanadoo.nl/adsl/info_adsl_go.html).

Another example, which is a small variation of this business model, is shown in the following figure:

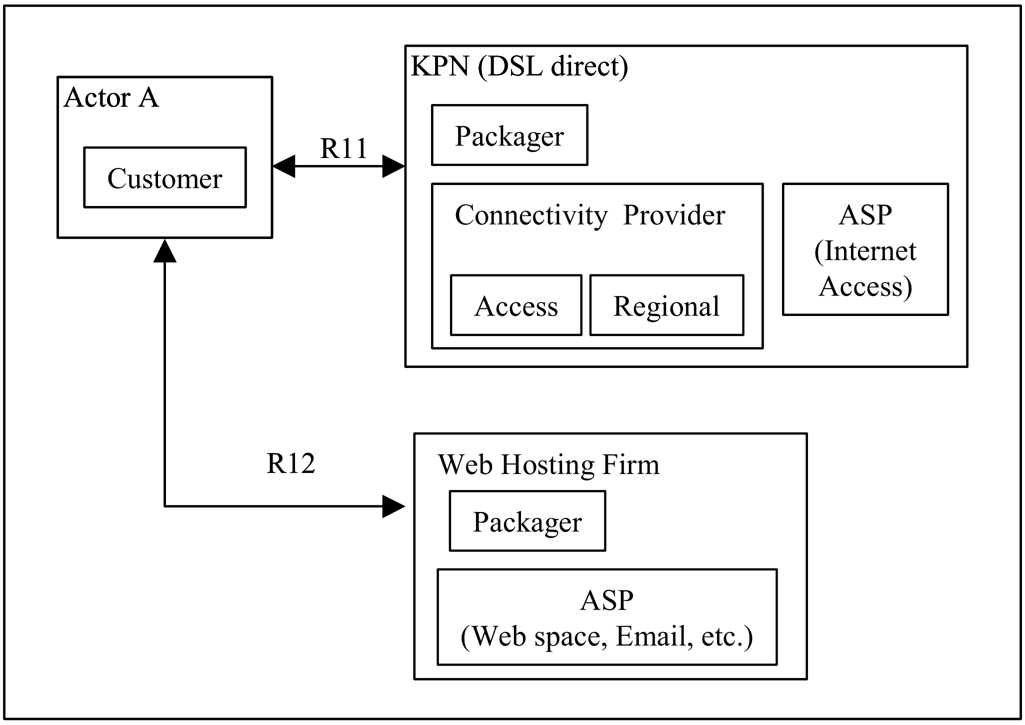


Figure 22. Example of a modified Independent Service Provider Model

In this example actor KPN plays the roles of packager, connectivity provider and ASP (only for internet access) and has a business relationship R11 with the customer for this. The customer has a separate business relationship R12 with another actor (Web hosting firm) for a web home page and email.

3.2.4 Super Provider Model

In this model the customer has a business relationshipR1, with actor B for the connectivity and services. Actor B is a sort of super access provider who plays the roles of packager, ASP & content and connectivity provider. Even though this is possible, it is rarely practised. Typically Actor B is split into different daughter business entities or independent operating divisions within the same family of business ownership.

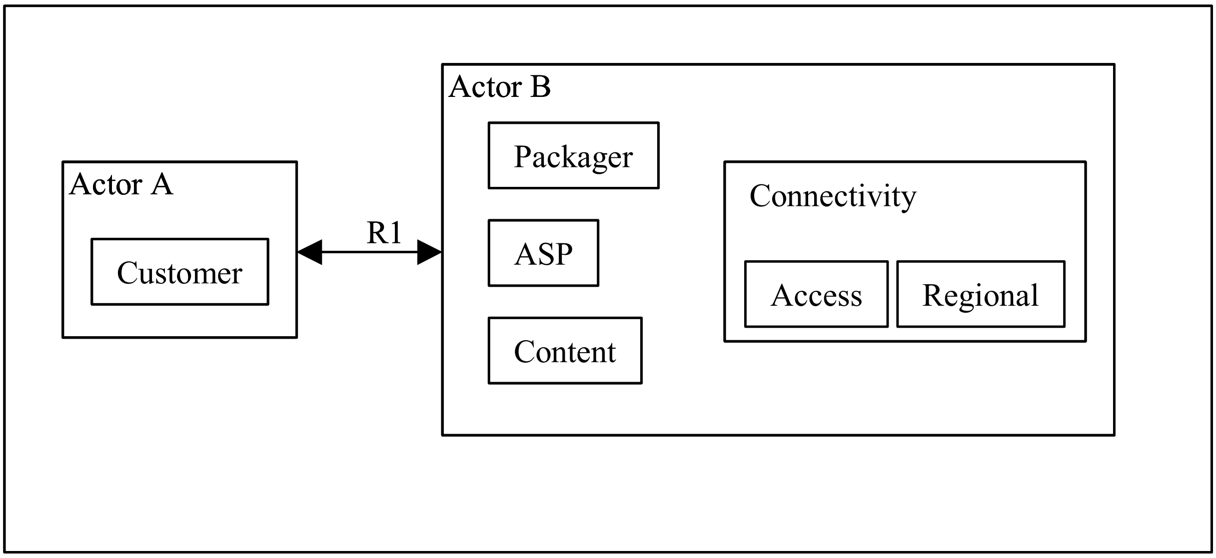


Figure 23. Super Provider Model

3.2.4.1 Business Relationships

There is only one business relationship (R1) in this model, that between the customer & the actor B (the super broadband provider). This includes the subscription costs for the connectivity and the services.

3.2.4.2 Cost Model

The capex & opex costs of the actor B (the super provider) in this business model are all reflected in the customer subscription via the business relationship R1.

3.2.4.3 Examples

An example of this business model is the yahooBB:

- (http://news.bbc.co.uk/1/hi/technology/3278375.stm
- & http://news.bbc.co.uk/1/hi/business/1464432.stm)

service in Japan, which owns the infrastructure, is an ISP, a phone service provider and application service(s) provider. Another example with the roles being distributed among mother & daughter companies is KPN and Planet Internet, XS4all & 'Het Net' in The Netherlands.

3.2.5 Public-Private Partnership - The BSA Approach

3.2.5.1 The Operator Neutral Network (ONN) Concept

First of all the BSA approach is very close to the so-called Operator Neutral Network (ONN) concept.

There has been and still are a large number of vertically integrated operators on the market controlling the end customer's access to broadband services. Operators that control all levels in the value chain, or at least most of the levels, are vertically integrated. A broadband value chain consists of different levels from infrastructures (fibres and copper), through operation and maintenance to provision of services and content and finally end customers. An example of this is the Danish TDC, the company that constituted the former Danish telephone monopoly. The company consists of different subsidiaries within different business areas, all within the same group – TDC. TDC owns and operates almost the entire Danish telephone access network and the biggest fibre network in Denmark. TDC provides services and content. They seem to aim for control on all levels in the value-chain.

Pricing and so-called vertical integration has a relationship. The effects of vertical integration are very often; high prices and that the operators have the power on their side and can principally dictate rules and requirements to the end customer. TDC has often been accused, by network operators, for their high co-traffic fees to admit other operators to get access to the Danish telephone network. This fact should be considered a big problem for the competitive market. Many operators have built their own access network but still, TDC owns the nationwide telephone network.

ONN's can be defined as:

A network where the connected subscribers – households and companies – have a possibility to choose between several different and competitive service providers, both for communication from/to Internet and for different content providers.

This is the core in the ONN concept - to give the end customer control over the services and content that he/she wants. Another very important thing is openness in the networks, i.e. that all service and content providers are welcome to connect, presuppose that they do not deliver any kind of offensive or discriminating content.

A big difference with ONN's compared to vertical integrated structures is that ONN's have separated levels in the value chain, i.e. no single provider/operator should control more than one level in the value chain.

ONN's provide a tool for competition and an increased freedom for the end customer to choose between different service providers.

The rest of the European Union is also moving towards these ideas with neutral platforms and increased competition to benefit for end customers and service providers.

3.2.5.2 BSA as connectivity provider and packager:

In this case BSA actually interfaces the end users and is responsible for e.g. billing. In this case BSA takes the roles of connectivity provider and packager.

This will mainly be the case with the smaller networks (or passive networks) that sees an opportunity to outsource a number of assignments to BSA.

BSA will be the one that supervises and operates the active parts of the combined network. Where the active parts is the network includes the necessary equipment to make the transfer of information possible, such as servers and routers. BSA will also sign agreements with numerous service providers (to increase the number of options for the end users) and connect new networks to increase the number of active users.

The passive networks is for instance owned by the big real estate owners or tenant-ownership associations plus the Campus Net, Apartment Net, …

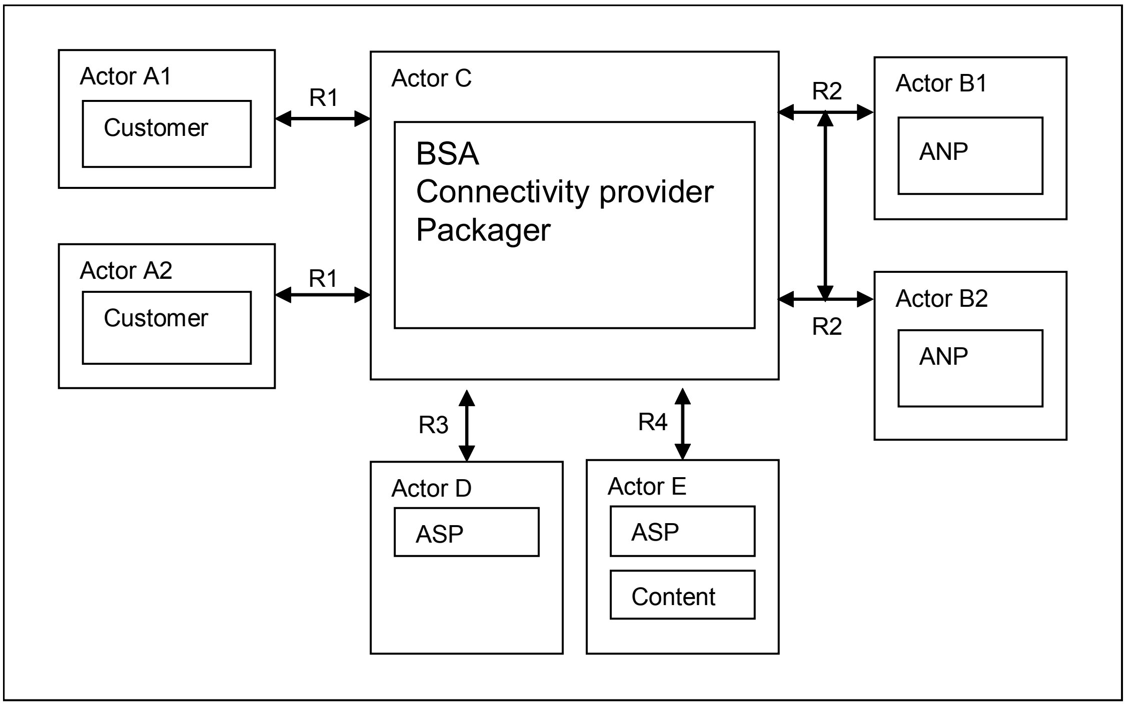


Figure 24. BSA as connectivity provider and packager

The customer has a business relationship R1 with Actor C, which is BSA. The business relationships can have a variety of forms:

- It can be the student who lives in one of the 8+ connected campuses in Aarhus,
- It can be the private business who has already formed a small gigabit network or,
- It can be the private end-user who is connected through a small network in an Apartment net.

The business relationship R2 is in fact also the connection between the independent networks B1, B2 to Bn (illustrated by the vertical connection).

In that way all the customers A1, A2 to An can communicate with each other through the combined network and not necessarily use the internet.

3.2.5.2.1 Business Relationships

In this model there are two major business relationships

1. The business relationship between the access network providers (the independent network owners) and connectivity provider and packager (R2) for the connectivity and the service (the level of service depends on the size of the network - can the network owner handle it themselves or do the want to use the services offered from BSA).
2. The business relationship (R3 and R4) between the connectivity provider and the ASP for a number of services. These services could be Internet access, Video on Demand, Voice on IP, etc. It is important to stress that there should be room for competing ISP's and ASP's in order to secure a wide and differentiated offer to the customers.

3.2.5.2.2 Cost Model

The capex costs are concentrated in the role of the different access network providers, actor B1, B2… in the figure, while the opex is handled by the connectivity provider, actor C.

3.2.5.3 BSA as connectivity provider:

In some cases the network owner (e.g. the Aarhus University network) will still be the interface to the end-user (students, teachers, researchers and employees) and thereby acting as the access network provider.

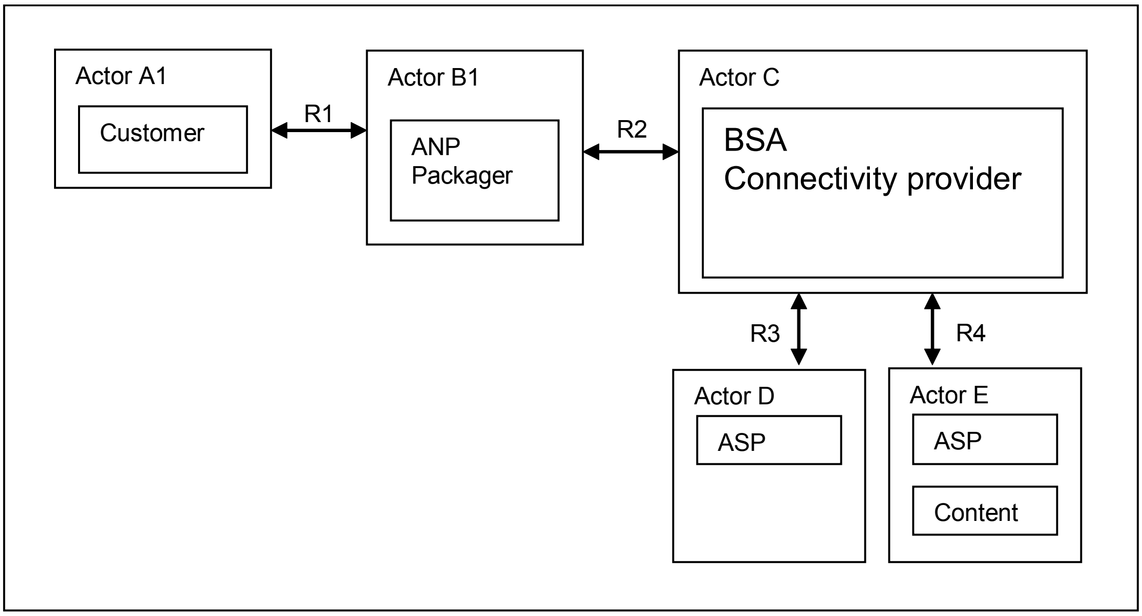


Figure 25. BSA as connectivity provider

Here BSA acts as connectivity provider and the independent network owners are the access network providers (ANP) and packager.

In this approach, the customer Actor A1 is the end-users in different operator neutral networks.

The customer has a business relationship R1 with Actor B1, which are ONN owners (access network providers) in Aarhus (The Municipality, The County, Aarhus Business School and Aarhus University). The business relationships can have a variety of forms:

- It can be the public worker who is connected to the Municipality/county network at the work place and also at the home office
- It can be the teacher or the student at the Aarhus University or Business School

Actor C is the way that BSA operates.

BSA finds the independent networks and connects them via Aarhus Internet Exchange (AIX).

BSA as a connectivity provider finds and connects the best ISP's and ASP's to the AIX (business relationship R3 and R4). BSA can via the accumulated number of users from all the independent networks get better conditions concerning bandwidth and price from ISP's and attract ASP's who can see a great potential in approximately 100.000-200.000 end users in the combined network.

Another possibility is that a number of the smaller networks will see an advantage in getting BSA to handle all technological and billing issues for them.

Actor D provides e.g. VoIP and Videotelephony.

In this way the network ownership is separated from the service provisioning and end-users can choose freely between different service providers that connect to the network through the traffic exchange point (AIX).

3.2.5.3.1 Business Relationships

In this model there are two major business relationships

1. The business relationship between the access network providers and packager (the independent network owners) and connectivity provider (R2) for the connectivity and the service (the level of service depends on the size of the network - can the network owner handle it themselves or do the want to use the services offered from BSA).
2. The business relationship (R3 and R4) between the connectivity provider and the ASP for a number of services. These services could be Internet access, Video on Demand, Voice on IP, etc. It is important to stress that there should be room for competing ASP's in order to secure a wide and differentiated offer to the customers.

3.2.5.3.2 Cost Model

The capex costs are concentrated in the role of the different access network providers, actor B1, B2… in the figure, while the opex is handled by the connectivity provider, actor C.

4 ASSESSMENT FOR FURTHER EVALUATION

This chapter will give some guidance how to approach the business modelling for the assessment and definition of use cases in milestone MA3.2 respectively the DA3.1.

It raises not the claim of completeness but rather it should be understand as a collection of possible solutions in order to apply the business models.

In general it will define a practical approach for establishing the business models and the distribution of the potential revenues related to the chapter 2.

All different business models which have been described in chapter 3 can be applied for the techno-economic use case investigations.

For simplification we describe in the first step just two models in detail. All parameters will be described and the modelling for each parameter will be explained. The values have to be developed when we assess and define the first use cases within the milestone MA3.2.

This chapter starts with an introduction of some theoretical basis functions which will describe some major parameters and which introduces the general elasticity of the estimated parameters.

In principle tree different strategies mark the both extremes and the combined approach of the business strategies that can be applied:

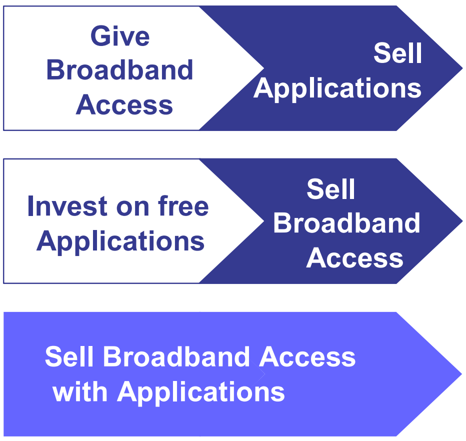


Figure 26. Different business strategies

4.1 Theoretical basis

The demand depends on many controlled and uncontrolled parameters [6] like:

- the price (controlled parameters linked to the demand by the price elasticity)
- the economical environment (uncontrolled parameters)
- the service (or the value perceived by the customer: controlled parameters)

=> DEMAND = f (P, S, E)

where P = price

S = service

E = environment

In the telecommunication area, we see various pricing models and the most common one is a combination of a connection price with a monthly fee + a traffic fee:

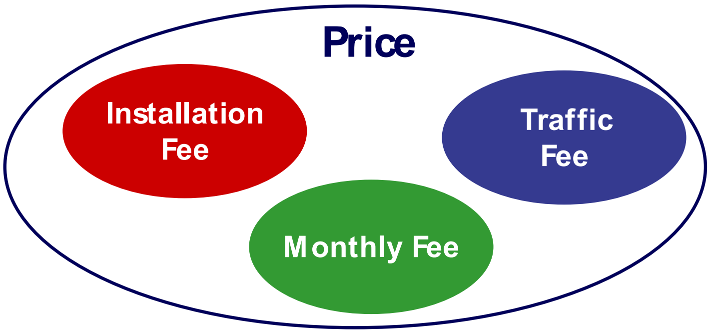


Figure 27. Price types

There are various pricing strategies that can be used depending on the product and the marketing strategy:

The pricing model is often linked with the product. For example, the flat rate is the most frequently applied to broadband access when the "infrastructure selling" is the most frequently applied to mobile services.

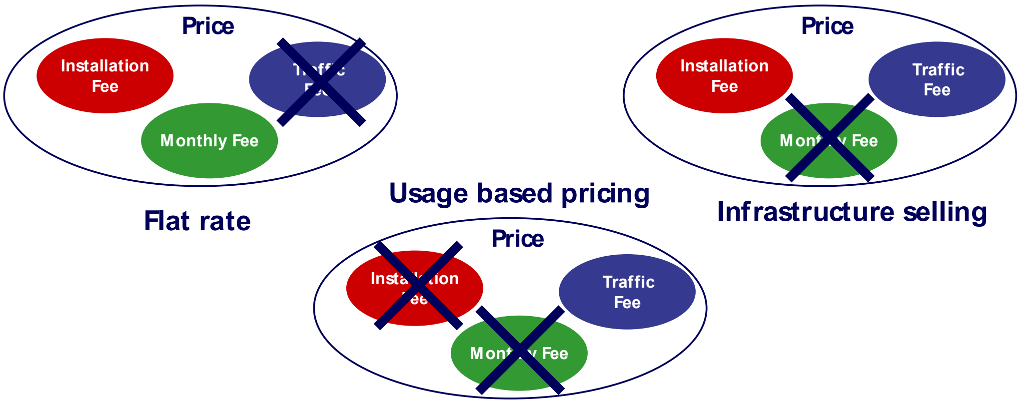


Figure 28. Pricing strategies

In the broadband access area, the most common pricing is a connection price combined with a flat rate monthly fee. The demand is then the following:

=> DEMAND = f (C, M, S, E)

Where C = connection price

M = monthly fee (flat rate)

Working on business models means to modify the price structure, the price level and the service whereas the environment remains uncontrolled. Therefore we can consider the demand as follows:

=> DEMAND (E) = f (C, M, S)

The dependency of the demand in function of the various parameters is not known. Determining it required important statistical studies and will probably introduce further dependency like: culture, country, time, buying power, ... This is not our goal here to determine them.

In a first approximation, we consider linear dependencies, around the forecast demand use in the model, in function of each parameter. This means that the demand looks like the following (linear approach):

$$\Rightarrow \quad \text{DEMAND (E)} = \frac{\alpha * S}{(\beta_1 * C) + (\beta_2 * M)}$$

Where α = service elasticity

β_1 = "connection price" elasticity

β_2 = "monthly fee" elasticity

In practise it means for example in case of the monthly fee some discrimination approach in order to increase the market share based on the customer's "willingness to pay". Different product or service offers can be assumed in order to activate different customer groups with a different level of "willingness to pay" for the service based on different SLA's or QoS levels.

4.1.1 Elasticity for broadband services

Defining α

α determines the attractiveness of the service from a qualitative point of view. This value will be extrapolated from previous market volume consideration. The previous demand curves will be the starting point and all new demand figures will be extrapolated from them.

Defining β1

As the information is missing for determining the β_1 parameter, defining the variation of the demand with the connection price, a simple assumption considering that, with a non changing monthly fee, the demand will be multiplied by 4 when the connection price is divided by 2.

=> β_1 = 2

Defining β2

The information is missing as well for determining the β_2 parameter. We do the same assumption as before:

=> β_2 = 2

4.1.2 Logarithmic approach

Another approach to estimate demand elasticity is by way of logarithmic modelling:

DEMAND (E) = $ß_1$ ln(M) + $ß_2$, where M stands for the monthly fee (as a function of the actual market demand).

Thus, the function 'monthly fee -willing to be paid- of the service against market demand', in an example related to broadband 3G mobile service provision, might look as follows:

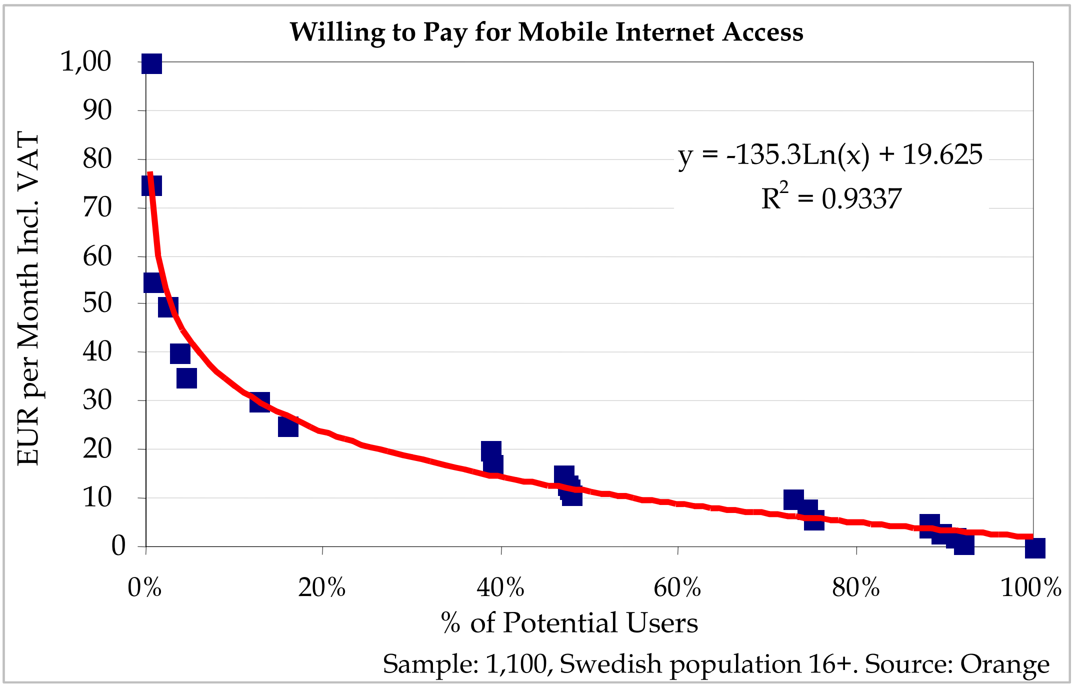


Figure 29. Example: Willingness to Pay for Mobile Internet Access

Where R^2 is the *coefficient of determination*, which indicates how much of the variation in 'y' is explained by the explanatory variable 'x'. The greater the value of R^2, the more the variation in the dependent variable is explained by the selected independent variables (the square root of the coefficient of determination would be the product moment correlation coefficient in the case of linear regression of a straight line, the product moment correlation being a number between 1 and -1). If R=1, then there is a perfect, positive relationship between the dependent and explanatory variable. A perfect relation implies that every data point lies on a straight line. If R= -1, then a perfect negative relationship exists, and if R=0 there is no relationship.

4.2 The Network Operator focussed Business Model

The access network operator organises its business around the sale of **access connectivity product** in quantity to ISPs for resale purposes. The ANP collects the customer's fees and payments and distributes partially to the other actors like ASP's and possibly CP's.

This business model refers to the chapter 3. The Connectivity Provider, in this case the Access Network Provider (ANP 1.2.4) takes the role of the packager and has the direct relationship to the customers.

4.2.1 Network Operator Investments

The ANP investments are quite high. All network elements (node and link related) have to be taken into account. The investment model is based on considering the yearly depreciations of the total investments. Alternatively the related rental costs in case of using third party resources have to be taken into account. This is applicable for both incumbent as well as competitive ANP's.

4.2.2 Maintenance cost model

The integrated maintenance cost model of the TONIC tool will be applied. This model is based on a certain percentages of the investment. This amount will be used for maintaining the different network elements of the ANP.

4.2.3 Operations and Administration cost models

The typical sources for the Operations and Administration costs of a ANP are listed in Table 2, including the cost drivers.

Table 2 – ANP Operations and Administration cost types and drivers

Operations and Administration cost type	**Cost driver** (generic model)
NETWORK OPERATIONS	Accumulated investments and value of rented components (infrastructure & equipments)
Network Management & license costs	Accumulated investments and value of rented components (equipments)
Marketing and Sales	Revenues, Discrimination of the services
Service launch marketing	Potential market (or number of subscribers at the end of the study period)
Customer support	Number of customers

4.2.4 Parameter for the Network Operator focussed Business Model

This section only includes the descriptions of parameters and values for the O&A cost models. The certain parameter values have to be defined in common with the definition and assessment of the use cases (MA3.2).

Table 3 – ANP Operations and Administration cost parameters and values

Operations and Administration cost type	**Parameter value**
NETWORK OPERATIONS, INCL. MANAGEMENT AND LICENCE COSTS FOR THE NETWORK ELEMENTS	% of accumulated investment *1
Marketing and Sales (billing, stat. collection, …)	**% OF REVENUE**
Service launch marketing	X € / potential customer / new service *2
Customer support (network)	x Man-Year per x subscribed customers
Customer support – efficiency improvement per year	Certain % per year

*1 For the reason of simplification, the "Network Management & licence costs" are included within the Network operations costs. Additionally no differentiation between infrastructure and equipment investments has been made.

*2 For the calculation of this model, the costs that has been assigned for the service launch marketing. Only the ISP will have significant costs regarding the service launch.

4.2.5 ANP market share

Today, in Europe the market for the residential broadband access is shared among different access providers, which are the traditional telecom operator using its twisted pair copper network, the cable TV service provider using its cable infrastructure and the wireless access. The business model takes already into account a "technology based" market share for the broadband access based on DSL technology.

In addition, the market share of the DSL network operator today depends as well on the existence or not of the Unbundling Local Loop (ULL). The next table shows the model made for the ANP market share in each area type and depending whether the ULL is applicable or not. If ULL does not exist, the model assumes no copper line rental, and no new access competitor, which is going to install new copper lines in parallel to existing copper lines. Therefore, 100% of the copper lines remain to the access operator for deploying for instance the DSL technology.

Table 4 – ANP market share versus unbundling Local Loop

Market	Residential	Business
ANP MARKET SHARE, NO ULL, ALL AREAS	%	%
ANP MARKET SHARE, WITH ULL, DENSE URBAN AREA	%	%
ANP MARKET SHARE, WITH ULL, URBAN AREA	%	%
ANP MARKET SHARE, WITH ULL, SUBURBAN AREA	%	%
ANP MARKET SHARE, WITH ULL, RURAL AREA	%	%

The business model with different market share should be built considering copper rental and ULL environments.

4.2.6 Parameters for the Access Network Operator model

The assumptions made and used for the ISP model are listed in Table 8 and Table 9.

Table 5 – ISP third party rental cost parameters and values

Third party service rental cost type	Parameter
ANP, CONNECTION FEE	x € (residential & business)
ANP, monthly fee, considers just the access network connectivity	% of residential retail price % of business retail price
Core Network coverage, one-time fee	X €
Core Network to ISP redundant links, connection set-up	X €

Core Network, monthly fee	€ / Mbit/s
Core Network link, price discount	Example: 0.5% discount for each 10 Mbit/s, max 30% discount
Core Network link tariff erosion per year (price decline)	% / year
Internet access (gateway to Internet)	Example: 1 000 € / Mbit/s / month + 25% for each capacity doubling [1]
Internet access tariff erosion per year (price decline)	% / year

4.3 The Service Provider Focussed Model (Wholesale Model)

The NSP (ISP) organises its business in order to resell provisioning and access connectivity to the Internet. Additionally, the ISP might offer supplementary services like for instance e-mail and web site hosting. He has a direct relationship to the customer, to the connectivity provider and to one or more other ASP's. The ISP collects the total prices and fees from the customer. The ISP has to seed back the related amounts to the other actors.

4.3.1 ISP Investments

The investments from ISP are basically very limited in comparison with a network operator.

Nevertheless, the ISP model takes into account:

- Identification and authentication server including the Radius and Proxy server for the customer databases (1 server per xxx customers)
- A one-time fee for the core national coverage
- A one-time fee for a redundant link to the core network

The two last cost factors are in this model considered as investment costs (CAPEX), because these one-time expenditures are necessary to set-up the business and will last for the complete study period.

4.3.2 ISP Maintenance cost model

The integrated maintenance cost model of the TONIC tool will be applied.

4.3.3 ISP Operations and Administration cost models

The different sources of the Operations and Administration (O&A) costs are listed in Table 6, including the cost drivers.

Table 6 – ISP Operations and Administration cost types and drivers

Operations and Administration cost type	**Cost driver**
NETWORK OPERATIONS	Accumulated investments
Customer Management & license costs	Total equipment investment (or number of subscribers to be managed)
Marketing and Sales	Revenue
Service launch marketing	Potential market (or number of subscribers at the end of the study period)

Customer support	Number of customers

4.3.4 Rental cost model

A number of rental services and expenditure occur in the business case of an ISP. These are listed in the Table 7, including the cost driver.

Table 7 – ISP third party rental cost types and drivers

Third party rental cost type	**Cost driver**
ACCESS NETWORK	Number of customers
Access network new connections	New customers
Core Network usage	**DATA VOLUME TO BE TRANSFERRED**
Internet Access	Data volume to be transferred to Internet

4.3.5 Parameters and values for the ISP model

The assumptions made and used for the ISP model are listed in Table 8 and Table 9.

Table 8 – ISP third party rental cost parameters and values

Third party service rental cost type	**Parameter**
ACCESS NETWORK, CONNECTION FEE	x € (residential & business)
Access Network, monthly fee	% of residential retail price % of business retail price
Core Network coverage, one-time fee	X €
Core Network to ISP redundant links, connection set-up	X €
Core Network, monthly fee	€ / Mbit/s
Core Network link, price discount	Example: 0.5% discount for each 10 Mbit/s, max 30% discount
Core Network link tariff erosion per year (price decline)	% / year
Internet access (gateway to Internet)	Example: 1 000 € / Mbit/s / month + 25% for each capacity doubling [1]
Internet access tariff erosion per year (price decline)	% / year

Table 9 – ISP Operations and Administration cost parameters and values

Operations and Administration cost type	**Parameter**
IP SERVICE OPERATIONS	Included in the customer support
Marketing and Sales (billing, …)	% of revenue
Service launch marketing	x € / potential customer / new service
Customer support (ISP)	x Man-Year per x customers

Customer support – efficiency improvement per year	%
Cost of employee	e.g. 70 000 € / year

4.3.6 Parameters for the ISP tariff model

The service pricing is based on the retail-pricing model defined within the MUSE WP A3.

Table 10 – ISP tariff parameters and values

Tariff parameters	Parameter value
BASIC TARIFF FOR RESIDENTIAL, PER 1 MBIT/S ASYMMETRICAL SERVICE	xx € / year
BASIC TARIFF FOR BUSINESS, PER 2 MBIT/S SYMMETRICAL SERVICE	xx € / year
TARIFF INCREASE FOR EACH CAPACITY DOUBLING FOR RESIDENTIAL CUSTOMERS	%
TARIFF INCREASE FOR EACH CAPACITY DOUBLING FOR BUSINESS CUSTOMERS	%

4.3.7 ISP market share parameters and values

Market share might vary significantly from one ISP to the other. As an example, in 2002 and in Switzerland, the incumbent DSL ISP still maintains a market share over 60%. The 20 other competing DSL ISPs share the rest of the market. The model that can be used for the ISP model is listed in the Table 11.

Table 11 – ISP market share

Market	Parameter
INCUMBENT ISP MARKET SHARE (RESIDENTIAL & BUSINESS CUSTOMERS)	%
COMPETITIVE ISP MARKET SHARE (RESIDENTIAL & BUSINESS CUSTOMERS)	%

5 ANNEX 1: CASE STUDY: PORTUGAL

5.1 Introduction

5.1.1 Objectives

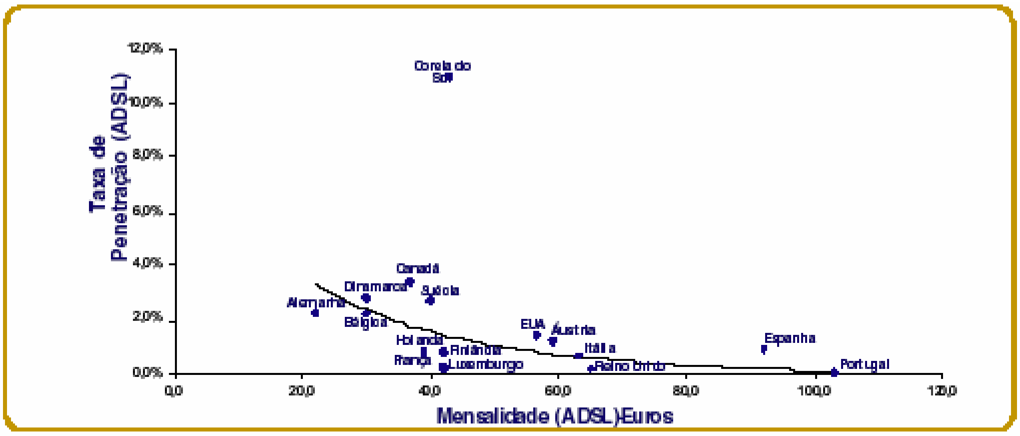
This document intends to present the recent Evolution of Portuguese tariffs and penetration rates of Internet broadband services. These values would be an input for technical-economics to be done under MUSE project afterwards.

5.1.2 Scope

In the specific context of telecommunications, the Portuguese regulator has sought to accompany the evolution of broadband services and networks, particularly for Internet access.

This accompaniment has led to study of the evolution of recently introduced broadband accesses. In the case of Internet accesses by coaxial cable, the first retail customers emerged in 1999, while the first ADSL retail customers only appeared in 2001.

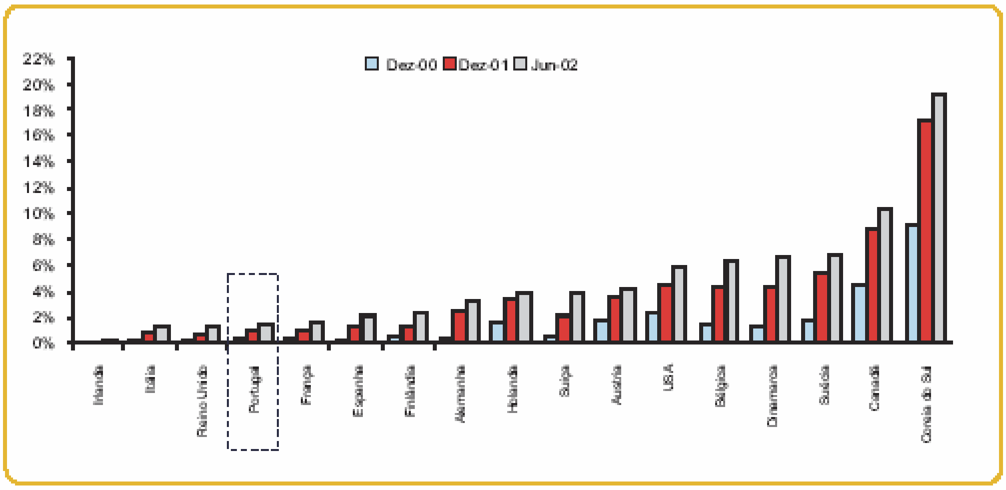
According to OECD, during 2001 Portugal had one of the lowest penetration rate and the more expensive tariffs for broadband services, namely in the ADSL access.



Fonte: OCDE, 2001

Figure 30. Portuguese penetration rate vs. tariffs for ADSL service in 2001

In the same context, Figure 32 shows the evolution (from Dec'00 to Jun'02) of the Portuguese penetration rate for broadband accesses, compared to other OECD countries.



Fonte: OCDE

Figure 31. Evolution of Portuguese penetration rate for broadband access compared to OECD countries

As this is a relatively recent service, its penetration in June 2002 – 1.5 percent – was not very significant. Important growth rates have nevertheless been verified. Between mid 2002 and end 2003 the penetration rate grew from 1.5% to 5% of the population. This trend can be justified by the decrease in the tariffs, currently rounding 35 Euros (monthly fee).

At the end of 2003, there was in Portugal a total of 52 entities authorised to provide internet access service were registered at the end of 2003, of which 25 were operational. Of the non-operational entities, 14 had yet to begin activity, while 13 were not providing the service as they had either ceased or suspended provision of same, while maintaining the respective registration.

5.2 Internet services Penetration rates

Global access (dial up and broadband)

According to the Portuguese regulator, at the end of 2003 the number of Internet access service customers in Portugal was approximately 7,211,000, growing about 39.6% over the end of 2002. The number of customers for the dial-up access mode grew by nearly 36.8% over the total at the end of 2002, accounting for 93% of all service customers.

When looking at these numbers, one must be aware of some overestimation of the number of dial-up access customers, because of the existence of situations in which the user has more than one ISP. In this way, customers must be understood as “Active ISP accounts”.

The following table presents the evolution of both dial up and broadband customers:

Table 12 - Evolution of Portuguese Number of customers for Internet services (dial up + broadband)2

	1999	2000	2001	2002	2003
Total No of Customers	**645.146**	**2.110.828**	**3.459.640**	**5.165.057**	**7.211.208**
Dial-up access customers	n.a.	2.083.613	3.360.324	4.902.294	6.708.089
Dedicated access customers	n.a.	2.061	2.709	3.298	3.198
ADSL access customers	n.ap.	n.ap.	2.886	52.005	184.344
Cable-modem access customers	297	25.154	93.721	207.486	315.577

Figure 32 shows the evolution of penetration rates in terms of “customers” (Active ISP accounts), including both “dial up” and broadband accesses.

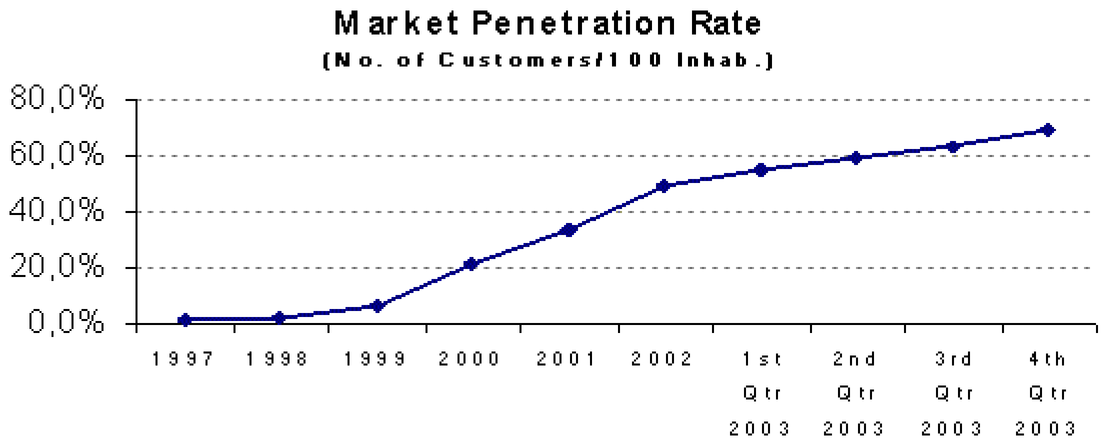


Figure 32. Evolution of the market penetration rate of Internet access service

Broadband access

Regarding broadband Internet access service, the cable-modem and ADSL modes together accounted for nearly 500,000 customers, corresponding to growth of 92.7% over 2002. This means that 6.9% of all customers (“ISP accounts”) accessed the internet by means of broadband accesses (cable-modem and ADSL).

Internet access offered via cable distribution networks accounted for more than 315,000 customers at the end of the period under review, while the access via ADSL accounted for more than 184,000. About 63.1% of all broadband customers used internet access by cable (36.9% for ADSL access).

Figure 33 shows the Portuguese evolution of penetration for Internet Broadband services (Cable and ADSL accesses).

[2] The offer of Internet access service by dedicated lines (rounding 3 thousand customers) uses several technologies and is mainly classified in “broadband”, particularly addressed to the business category. It includes the offer of the service through FWA (fixed wireless access) accesses.

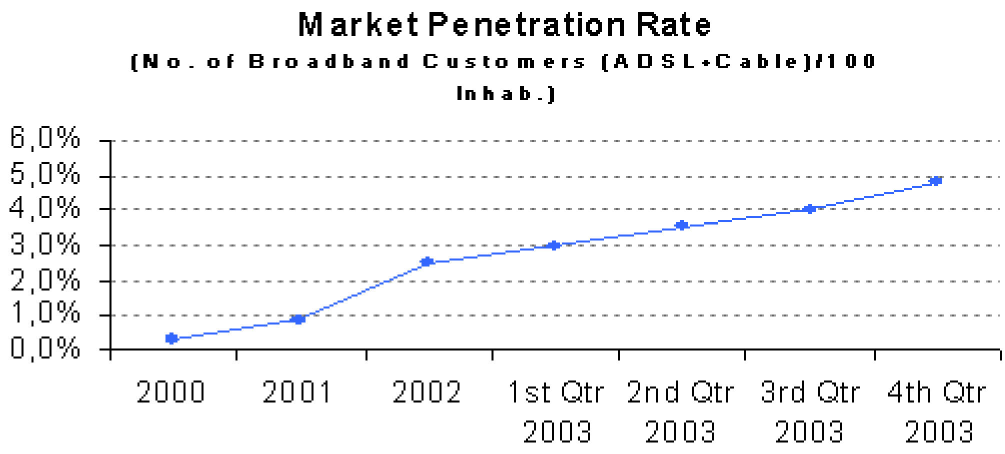


Figure 33. Evolution of market penetration rate of broadband Internet services

The next graph (Figure 34) shows forecasts, on June 2002, on the broadband services penetration rate from 2002 to 2005. According to that, it was estimated a penetration rate in 2005 between 6,6% and 9,1%.

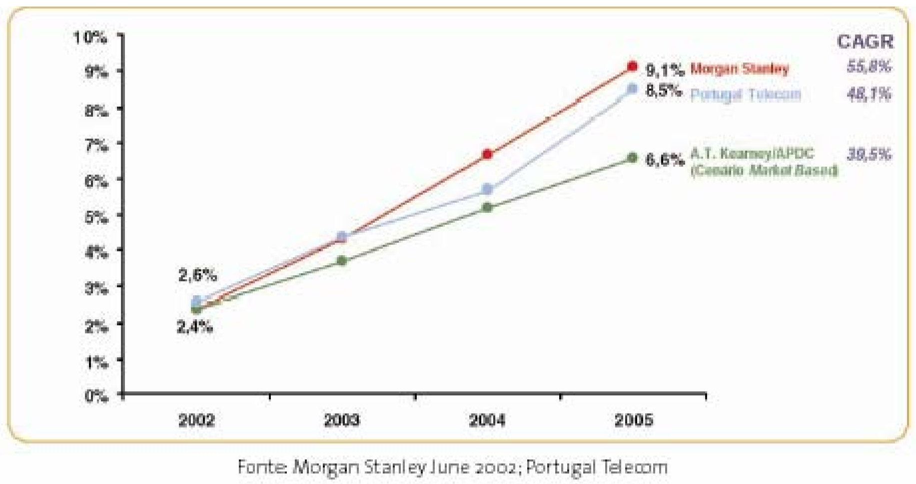


Figure 34. Portuguese penetration rates from 2002 to 2005

5.3 broadband Internet services tariffs

Looking at the prices charged by the ISPs on the Internet services, they have varied not only on the kind of end user, but also on the chosen timetables and type of contract (subscription or prepaid).

In the case of broadband accesses, the price differences result from access speed, quantity of traffic included, number of associated users, number of mailboxes, available capacity for personal pages, existence of fixed or dynamic IPs and kind of access (xDSL or cable modem).

Regarding the access price in broadband, it is quite important to refer the existence of flat rates, which allows users better control of costs.

According to that, the following tables present the prices currently (1st qtr 2004) being charged, but only considering the following relevant parameters:

Access speed (Kbps);

Quantity of traffic (Gb);

Time limit (hours);

Setup and monthly fees.

Table 13 - ADSL Access

	Access speed (kbps)		Quantity of traffic (Gb)		Time limit	Fee (Euros)	
ADSL	**Download**	**Upload**	**National**	**International**	**(hours)**	**Setup**	**Monthly**
Light	256	128	unlimited	unlimited	10 hours	25	22,5
Standard	512	128	20	2	always on	25	35
Pro	512	128	unlimited	4	always on	25	50

Overcoming the traffic limits defined, implies an additional fee of 1,5 Euros per 0,1 GB.

Table 14: Cable Access

	Access speed (kbps)		Quantity of traffic (Gb)		Time limit	Fee (Euros)	
Cable	**Download**	**Upload**	**National**	**International**	**(hours)**	**Setup**	**Monthly**
Speed Light	256	128	unlimited	unlimited	10 hours	25	22,5
Speed ON	640	128	20	1	always on	25	35
Speed USE	640	128	unlimited	unlimited	always on	25	1,3€/hour
Speed Pro+	640	128	unlimited	3	always on	25	45

The package “Speed Pro+” has got other options with prices growing up to 115 Euros (150 Euros) with dynamic (fixed) IP and 10GB (40GB) for international traffic.

Overcoming the quantity of traffic for the traffic limited packages an additional fee of 2,5 Euros per 0,1 GB must be considered.

The time limited packages an additional fee of €1 per hour must be considered.

For all cable services is mandatory to subscribe the cable TV service not included in the broadband fee.

5.4 Portugal study conclusions

According to the data included in this document, one can conclude that Portugal have reduced more than 3 times the tariffs of broadband services in less than 3 years. As a possible consequence of this reduction, the penetration ratio has increased from 1% in 2001 to 5% in 2003.

This study was focused on the residential services. We can say that the standard monthly fee rounds €35 for both cable and ADSL services.

Further studies should be performed on the broadband business services as also on cable TV distribution.