VALUE-ADDED SERVICES FOR FIBRE TO THE HOME
Market Potential, Time Horizons and User Groups

Tom Evens, Lynn De Vlieger, Elke Boudry, Pieter Verdegem, Lieven De Marez
IBBT-MICT, Dep. of Communication Sciences, Ghent University, Korte Meer 7, 9000, Gent, Belgium

Erik Vanhauwaert, Koen Casier, Jan Van Ooteghem, Sofie Verbrugge, Bart Lannoo
IBBT-IBCN, Dep. of Information Technology, Ghent University, Gaston Crommenlaan 8 (bus 201), 9050, Gent, Belgium

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Abstract: Currently, telecom operators are developing large-scale projects in the internet broadband sector in cooperation with utility companies and public institutions. The roll-out of fibre to the home network infrastructure is often justified by the supposed increasing user demand for high-bandwidth applications. Starting from a user-oriented perspective, however, it is important to consider the utility of fibre networks for future users and to explore those killer applications that can convince end-users to migrate from their current connections to high-bandwidth networks. By means of an international expert survey, this paper tries to identify value-added services that benefit from fibre's network potential in terms of high speed, symmetry and low delay. In contrast to initial expectations, video delivery applications were found less convincing by the experts whereas health monitoring, online content storage and management services, and desktop sharing were identified as the most promising fibre applications. In terms of timing, content storage and management systems and desktop sharing are identified as more market-ready than health monitoring applications. Whereas the health monitoring and desktop sharing are mainly seen as a service only for the consumer and business market respectively, content management systems are considered useful for business as well as for consumer purposes.

1 INTRODUCTION

Countries and cities all over the world currently are in the process of developing large-scale projects in the internet broadband sector. In most cases, these initiatives are driven by public-private partnerships (PPP), that align the interests of different private and public players. Typical examples of private players in such cooperation are network operators and service providers. Public parties involved are often local communities, municipalities and governments. With these considerable investments in upgrading network infrastructure, all stakeholders are eager to provide innovative and advanced broadband services to various user groups and tap into a new pool of revenues (Nuccaiarelli, Sadowski and Achard, 2010). Public parties justify the roll-out and deployment of next-generation networks (NGN) by the desire to improve the 'quality of place' for citizens and enterprises. This high-speed network infrastructure should not only function as an economic engine for attracting more companies and creating new job opportunities, but is sometimes believed to close the persistent social and digital divides. Although this belief seems a bit techno-optimistic and is worth a discussion (see Dolente, Galea and Leporelli, 2010), the debate lies not within the scope of this paper.

Another, and probably more powerful, argument for rationalising the vast investments in large-scale network infrastructure projects is the increasing user demand for high-bandwidth applications. According to Nielsen's Law, postulated in 1998, the available bandwidth to high end-users increases with fifty percent per annum on average and the mass market lags the high end-user by two-three years (Nielsen, 1998). This law predicts that 100 Mbps will be available in 2015 and 1 Gbps in 2020. Thanks to the increased deployment of next-generation network infrastructure (such as fibre), a growing number of

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countries are already providing services to the residential market with a bandwidth higher than anticipated by this law (albeit on a small scale). In Sweden, for example, 100 Mbps connections are available since 2004 in several areas of the country. Given the extensive residential fibre deployment and the growing rivalry among internet service providers (ISPs) in terms of pricing and capacity, Sweden is expected to pass the 1 Gbps milestone already in the near future (Ventura Team LLP, 2008).

In 1964, McLuhan stated that '*the medium is the message*' by which he meant that content is defined by the nature of its distribution mode. Following the rationale behind this phrase, the availability of high-bandwidth capacity should thus eventually result in the supply and consumption of bandwidth-intensive services and applications. However, it may be clear from the past that end-users are only willing to adopt new technology if this provides them with perceived added value and benefits (the so-called chicken-and-egg problem). With regard to fibre networks, Noam (2008: 2) notes that '*it is common to rush into talk of technology or rollout strategy without first considering the utility to users. If one builds an oil pipe one must first be sure that there is an oil supply at one end and demand for it at the other. The economic case for investment in super-broadband must rest on its meeting a demand/price combination that is not satisfied today*'. Especially in Europe, this demand for fibre networks is still mainly unproven. Whether the network operators' goal is to migrate existing DSL (or cable) customers to fibre or to position fibre as a superfast high-end offer, fibre technology is not yet a widespread success in Europe (IDATE, 2010). In general, the number of homes passed is still small and commercially available offers have not yet fully convinced potential customers, which seem satisfied with their existing connection, to migrate to fibre. Although prices for superfast broadband access are in line with or slightly higher than those charged for regular access, end-users are reluctant to switch to NGN providing more bandwidth capacity these days. If the perceived utility for end-users is not in access prices, the supply of value-added services will certainly have to provide this utility.

In this paper the focus is on the supply and demand for bandwidth-intensive applications. Following a user-oriented approach – instead of the more technological deterministic perspective – the paper tries to identify those services that offer added value and that benefit from fibre networks' potential in terms of high speed, symmetry, low delay and low jitter. Based on opinions of 21 international experts, this paper explores business opportunities for a limited set of services and applications, which might help in convincing end-users to switch from regular to ultra-broadband internet connections. In order to be sure that these services need NGN (in this case fibre), it is questioned whether or not existing infrastructure will suffice to deliver these applications with similar 'quality of service' (QoS) and 'quality of experience' (QoE)(De Moor & De Marez, 2008) .

2 DO WE REALLY NEED FIBRE?

'*If you build it, they will come*'. This 'adage' is often heard when talking about an innovative product or service. It implies that supply automatically evokes demand and that each innovation finds its way to the end-user. As this reasoning merely is an illustration of technological-deterministic approach, it does not provide sufficient arguments to convince operators to invest into expensive infrastructure in the short term. Currently, there is a lot of debate among experts whether fibre's bandwidth is excessive for services' requirements and whether existing network infrastructure would suffice to offer ultra-broadband applications. Hence, this section provides a brief overview of this debate – including some of the arguments held by fibre advocates and opponents – but also aims at going beyond this mainly theoretical discussion by offering technical application requirements and more quantitative argumentation of why fibre is an appropriate solution for realising value-added services.

2.1 Fibre Deployment

Whereas previously Digital Subscriber Line (DSL) and Hybrid Fibre Coax (HFC) were among the most prominent technologies to provide homes and multi-dwelling buildings with access to telecommunications services, fibre is increasingly used to deliver signals from the operators' switching equipment to houses or offices. 'Fibre' is the generic term for any broadband network architecture that uses optical fibre to replace all or part of the existing metal local loop used for last mile internet communications. With regard to the distance between the optical fibre and the connected end-user (the shorter this distance, the faster the connection), distinct configurations can be distinguished (see also figure 1):

- Fibre to the node (FTTN): fibre is terminated in a street cabinet up to 300 meter from the average end-user while the final last mile is connected by alternative distribution methods (wireless, copper, coax)

- Fibre-to-the-curb (FTTC): fibre is terminated in a street cabinet closer than 300 meter from the average end-user
- Fibre-to-the-building (FTTB): fibre terminates at the boundary of the building, the in-house connection continues over alternative in-building technologies
- Fibre to the home (FTTH): fibre continues indoors and reaches the living and working spaces

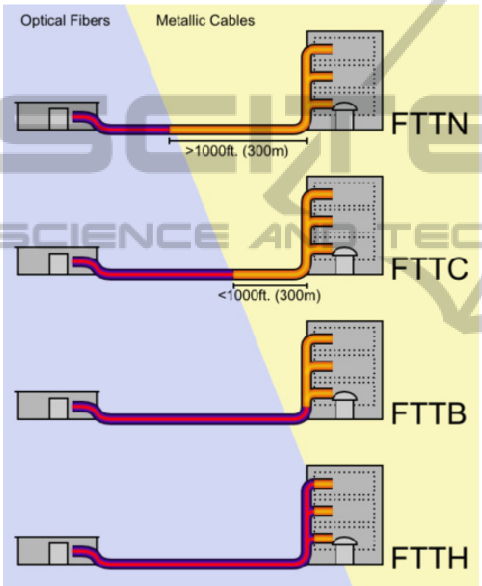

Figure 1: Fibre network configurations.

Compared to traditional infrastructure, the most obvious benefit optical fibre provides is speed. Fibre networks carry data by transmitting pulses of light, usually created by lasers, which turn these light signals on and off very quick. As these lasers are getting ever faster, higher speed data transmission is possible via the same network without the need to replace the fibre. Additionally, in contrast to other existing network media, the optical fibre is a medium with very low attenuation and dispersion of the signal. This allows optical networks to carry much higher bandwidths over longer distances with less loss and deformation of the signal (and content as such). Traditional upgraded network infrastructure (e.g. VDSL, DOCSIS) offers more problems for increasing bandwidths and current implementations typically ranging from 3 to 30 Mbps downstream and from 0.25 and 4.5 Mbps upstream capacity. Currently fibre offers downstream and upstream bandwidth of 100 Mbps even up to even 1 Gbps on the residential market. Business customers are often provided with much higher bandwidths over the same fibre. Along with speed, symmetry – identical downstream and upstream bandwidth – is an important fibre benefit. The combination of speed and symmetry allows for low latency and as a result improved interactivity. Finally, fibre networks allow for a more reliable and consistent signal. As fibre is almost immune to electromagnetic interference and eavesdropping, its connection is perceived more stable than traditional network infrastructure. From a user perspective, this ultra-broadband network infrastructure should result in enhanced services and an increased QoE.

However, a small amount of authors believes that existing network infrastructure will suffice to deliver enhanced applications and services to end-users in the future. Fredebeul-Krein & Knoben (2010), for example, argue that research shows limited evidence for increasing demand for high-bandwidth capacity and that people are rather reluctant to pay a price premium for fibre connections. In addition, telecom operators are facing regulatory uncertainty regarding future wholesale (*i.e.* will first movers be forced to open up their network to alternative access-seeking operators?), while technical progress may allow the current networks to deliver higher bandwidth. They claim that for telecom operators there are no obvious guarantees for a viable business case (Fredebeul-Krein & Steingröver, 2009). Noam (2008) also questions the viability of high-bandwidth content providers, which would have to invest heavily to develop innovative services without any guarantees considering return on investment.

This view is largely disproved by true broadband believers, who consider current networks incapable of meeting future bandwidth requirements, even if network operators would strongly invest to improve existing infrastructure. According to Huigen & Cave (2008: 714), *'the question is not so much whether a massive increase in bandwidth over fixed access networks is necessary, but rather when and how it will be realised'*. As the majority of applications demanding high-bandwidth is still to be developed, fibre is often said to be the most 'future-proof' technology. Referring to the traditional chicken-and-egg problem new platforms face, it is important to note that the availability of high-capacity services necessitates improved network infrastructure, while investments in upgrading networks may stimulate the development of capacity-sensitive applications

(Falch & Henten, 2010). This might mean that cities and countries can benefit from an ‘accumulation effect’. The more homes and buildings are passed with fibre, the higher penetration rates will be and the more novel applications will be developed. In this regard, the development and provision of services will benefit from economies of scale, both on the supply and the demand side.

2.2 Application Requirements

In order to evaluate the technical requirements for ultra-broadband applications with regard to existing and next-generation networks, one has to consider some properties of online communication networks (Comer, 2009). The best-known network parameter is the provided bandwidth, which defines the amount of information sent over the network (expressed in bits/second). A distinction should be made between download and upload capacity, and between average and peak bit rates that are processed over a digital communication network. In terms of bandwidth, video applications obviously require more capacity to send over a network compared to text files. While it takes about 5Mb to share PDF e-books, sharing full-length high-definition quality movies requires up to several Gbs. Depending on its duration and quality level, high-definition video such as internet-protocol television (IPTV) services require about 12.5 to 20 Mbps (see Charbonnier et al., 2008). For this reason, video-related applications should definitely benefit from increased bandwidth of next-generation networks such as fibre to the home.

Apart from bandwidth, delay and jitter are also important design and performance characteristics of a telecommunications network. Delay specifies the time needed for a bit to travel from one node to the other (typically measured in fractions of seconds) while jitter refers to the variance in this delay. These parameters are only critical in case of bi-directional and real-time applications such as video telephony and streaming. A smooth conversation requires that one hears the other with a delay of less than 100ms. Jitter is even more important than delay and can cause severe quality degradations, and is often solved by providing a buffer at the receiving end with a given average fill rate. These buffers however will also result in additional delay.

Table 1: Next-generation network quality parameters.

Service class	Delay	Jitter
Real time	< 5ms	< 1ms
Streaming	< 40ms	< 10ms
Transactional	< 100ms	N.A.

This overview of critical network parameters allows us to indicate the technical requirements for fibre-networked applications and to identify value-added services with market potential. In Table 1, the NGN quality parameters (in this case delay and jitter) are summarized. It is obvious that bandwidth-intensive applications relying on real time, streaming or/and transactional functionalities will capture the full benefits of fibre networks.

Table 2: Bandwidth requirements for end-user services (minimum case, in Mbps); (Charbonnier et al., 2008).

Service	2010	2020	2030
Voice	0.15	0.15	0.15
Video telephony	0.5-2	4	10
High speed gaming	0.25-2	4	60
Video on demand	1-3	20	200
Cloud computing	2-2.5	18	150
Live streaming	4-10	12.5	160
IPTV channel	4-10	12.5	160
IPTV zapping	5-15	15	208

In terms of end-users services, Table 2 provides an overview of the current and future requirements for broadband services as estimated in the OASE project. It becomes clear that current networks with limited bandwidth will hardly suffice for these future services’ requirements taking into account technological developments (e.g. the expected shift towards super high-definition and for some purposes 3D quality). In the case of video telephony (think of video conferencing and e-learning platforms), there should ideally be a two-way path high-quality video stream. Additional information (such as documents) can be shared as well, but as previously mentioned, the latter have considerably lower impact on bandwidth requirements. The current required impact for video telephony is estimated at 2 Mbps mounting up to 4 to 10 Mbps (both for upload and download) in the next decades. In addition, video telephony is very sensitive to delay and jitter. Considering a video surveillance application, delay and jitter will be less of a problem. A number of cameras (both in-house and out-house) could send high-quality video to a central server simultaneously, where the data stream is analysed and suspicious activity triggers an alarm. Assuming six cameras (ca. 12.5Mbps per stream) to cover all relevant areas inside and around homes and offices, an upload capacity of 75 Mbps is required. Another promising application is IPTV (digital TV), requiring 12.5 Mbps for each channel being watched or recorded (though in practice this can increase up to 20 Mbps). This requirement may mount up to 600 Mbps with ultra-high definition (UHD, Super Hi-

Vision) and 3D quality in the future. Finally, online back-up and content management systems could create added value to the end-user. By using cloud computing, media files created by the user can be safeguarded online instead of stored on a local space (requiring tens of gigabytes). As delay is less important for this service, network bandwidth is an important bottleneck. Unlike other applications, the bandwidth use of this application is less continuous, but occurs in burst in sync with the user's activity. For example, after shooting, a photographer wants to upload 400 high-quality photos (about 2 Gb). At an upload speed of 5 Mbps, it takes close to one hour while it takes about ten minutes at a speed of 25 Mbps. As the user wants to browse his pictures after uploading, it takes two seconds to load each photo, which feels very slow and unresponsive. To reach a response time lower than half a second, a download speed of 100 Mbps is required, and bandwidths of 500 Mbps or above can give the user an instantaneous feeling of the application for viewing his photographs.

2.3 Existing vs. Next-gen Solutions

The first mentioned discussion on fibre deployment could lead to the conclusion that existing network infrastructure should suffice to deliver some of the aforementioned services to end-users with a more or less optimal QoS and QoE. However, this discussion on bandwidth-intensive applications and the related technical requirements may be quite artificial. In real life, these applications will be used simultaneously within a family context. Assume a family household of four members where the father watches a particular television channel on the regular screen (while recording another one via the set-top box), and the son is viewing a football game via his tablet-pc. At the same time, the daughter is safeguarding her pictures online while the mother is making a video call with her sister living abroad. In this imaginary case, a download bit rate of over 50 Mbps is required (100+ is recommended) whereas the upload speed would have to be 17.5 Mbps (30+ is recommended) to guarantee an optimal QoS and QoE. Not to mention that some of these applications are sensitive to delay and jitter, which the users will experience in case the network is working at (close to) full capacity.

As delay and jitter in the network are not only determined by the access technology, but also by several elements in the network infrastructure, they have not been quantified within this study. Still, every buffer that has a faster connection (*i.e.* fibre) can contribute to a lower delay. Similarly, jitter is only expected to increase by fibre solutions when the newly provided applications seem so popular that the relative load on the network is increased significantly. Hence, the rest of this section will focus on bandwidth.

There is currently no large-scale fibre to the home network deployed in the Belgian market. The major players that dominate the market (Belgacom and Telenet) are experimenting with FTTH pilots, but no roll-out is planned to date. Regarding bandwidth, Table 3 – showing a typical and high-end service – indicates that the existing infrastructure in Belgium (as well as in many other countries) may prove insufficient to deliver the services discussed in this paper. It should be noted that in the Telenet case video is broadcast in a separate RF-channel not impacting downstream or upstream traffic. Additionally, it is necessary to note that the up- and downstream bandwidth is shared amongst all customers of the same coax line. In the Belgacom case, the bandwidth is dedicated per customer, but is used for both internet and video.

Table 3: Bandwidth of Belgian ISPs (bandwidth capacity in Mbps, prices in Euros).

	Telenet (cable)		**Belgacom (xDSL)**	
	Normal	High	Normal	High
Down	15	100	12	30
Up	1	5	1.5	4.5
Price	30	99	33	58

The overview shows that the upgraded network infrastructure (DOCSIS 3.0 and VDSL for Telenet and Belgacom respectively) hardly guarantees the optimal QoS and QoE for high-bandwidth services. While the download speed of the high-end solution of Telenet could suffice, the upload speed – just like the other solutions – fails to meet future bandwidth requirements. Since end-users attach great value to file-sharing and user-generated content, applications increasingly require symmetrical bandwidth (Cave & Martin, 2010). It should be mentioned that these offers are theoretical values. Telenet states on its website that measurements indicate that realistic speeds of both Telenet and Belgacom connections are about 75 percent of the bandwidths officially indicated. The lack of fibre to the home solutions in Belgium heavily contrasts with the 100 Mbps solutions offered in several other countries and parts of the world (in terms of penetration, Asia is the undisputable forerunner in deploying FTTH services) (see IDATE, 2010). The Belgian demand for, and large-scale roll-out of fibre to the home remains to date mere speculation. This is perhaps not because of limited demand and willingness to pay and demand, but has much to do with the existing duopoly in the broadband market. This dominance may depress investments in network optimization and at the same time hamper entrance of alternative operators, who are likely to reduce investments and seek access to the incumbents' improved networks.

Table 4: FTTH bandwidth offerings.

Country	Down (Mbps)	Up (Mbps)
the Netherlands	50	50
Sweden	1000	100
France	100	100
Portugal	200	20
United States	50	20
Japan	100	100
Korea	100	100

3 RESEARCH METHOD

The results are based on the interdisciplinary TERRAIN project (*Techno-Economic Research for futuRe Access Infrastructure Networks*), which focuses on a better cooperation between all public and private actors that are involved to optimize the roll-out of new telecom and utility networks, and to align the operational processes in a more consistent way. All aspects will be analysed from a techno-economic point of view, considering the technical, regulatory, economic and user-related sub-problems. In the remaining part of this paper, the focus will be on user studies.

In essence, the user studies within the project aim at identifying which applications and services have the potential to drive future adoption of fibre to the home networks, and which of these applications are fully appropriate to reap the fruits of superfast and high-bandwidth network infrastructure. As the focus of our first efforts was on exploring business opportunities, the primary goal of this study was to draw up and evaluate a long list of high-bandwidth and fibre-sensitive applications (use cases). This has resulted in valuable input for the next stages of the project including a large-scale end-user survey both to residential and business customers.

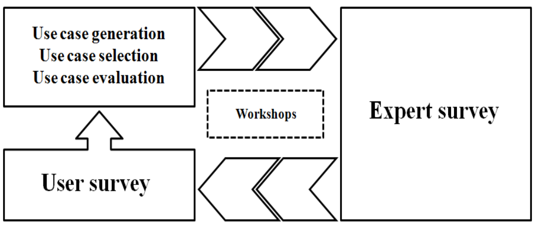

Figure 2: Research design.

Based on existing projects combined with literature research, a brainstorm session was organised to generate ideas for high-bandwidth applications. As a result, a long list of likely services was drawn up. This list was further discussed and refined in an interdisciplinary workshop with project partners. Eventually, a shortlist consisting of ten use cases was drafted:

- Surveillance cameras
- Virtual classrooms
- Health monitoring system
- Online multiplayer gaming
- Content storage and management
- Future Internet-protocol television (UHDTV and 3D)
- Video telephony
- Desktop sharing
- On-demand video streaming
- Immersive 3D tourist environment

To get a better picture of genuine drivers and use cases for FTTH solutions, it was deemed essential to take expert views and opinions into account. Therefore, a qualitative survey among international experts on fibre services and roll-outs was organised. A panel of international experts was derived from literature and personal contacts. All project partners were also invited to join the panel. All experts were sent a personal e-mail in which they were asked to complete an online questionnaire. In this questionnaire, the experts were asked about each service's likelihood, time horizons (in terms of technological feasibility, and reach of mass market) and most likely end-user groups.

A total of 21 experts completed the survey. Some 53 percent of respondents is working in public sector (especially research institutions) while the rest of the experts are mainly in the employ of equipment vendors and telecom operators. Most of them have a rather technical background, but a considerable part also indicated expertise in regulatory issues, content & applications and business models. In total, people from 8 countries participated in the expert survey.

4 RESULTS

4.1 Overall Use Case Popularity

In the survey, the experts were asked to choose their personal three most convincing services and to rank them subsequently. Based on their ranking, use cases were given five (ranked first), three (ranked second) and one (ranked third) point(s). These points were then summed resulting in a total score. Rather than the absolute scores for each application, the relative position of each service is more interesting.

Table 5: Ranking of applications.

Rank	Use case	Score	#1
1	Health monitoring system	18	3
2	Content storage/management	16	3
2	Desktop sharing	16	1
4	Virtual classroom	15	1
5	Online multiplayer gaming	14	2
6	Video telephony	11	2
6	Surveillance cameras	11	1
8	Internet-protocol television	6	0
8	On-demand video streaming	6	0
10	3D tourism environment	0	0

The resulting ranking brings to light some very interesting and perhaps unexpected conclusions. Health monitoring systems and online content management are clearly deemed most convincing, considering their high score and the fact that three experts rated them most convincing of all applications. The top three is completed by desktop sharing, beating an e-learning application and online multiplayer gaming. Without labelling these services as 'killer applications', they should be at least considered by service providers when rolling out fibre network infrastructure. These findings are somehow surprising since all the traditional video delivery applications – which were expected to benefit from fibre's high-bandwidth capacity – were found less convincing by the experts.

4.2 Time Horizons

In other parts of the survey, experts were asked about the time horizon along which the different use cases are expected to be available from a technical point of view and when they will reach mass market (*i.e.* be adopted by the early majority segments). With this, the study aimed to gather expert forecasts of the development and breakthrough of these services.

With regard to the underlying technology of the use cases, experts consider that most of the applications can be launched at this moment or within two years except for 3D internet-protocol television (Figure 3). None of the applications' underlying technology is said to be infeasible. Four use cases were found market-ready, amongst other content management and desktop sharing systems, respectively ranked as number two and three in the former 'killer application' ranking. Surprisingly, health monitoring systems – identified as the most promising service –

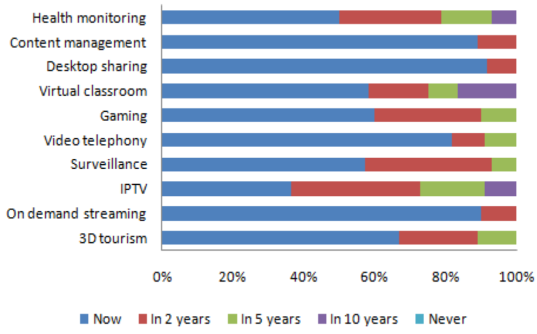

Figure 3: Time to technological feasibility.

were seen as less market-ready. Future television is considered the least plausible use case as the minority of experts indicated the current readiness of technology. These findings may suggest that technology will not be the main barrier for the deployment of high-bandwidth applications. Experts confirm that most applications can be brought to market within two years; only the future television services are considered to be more long-term.

Regarding market acceptance and penetration, it is remarkable that the three most technologically feasible services (*i.e.* content management, desktop sharing and on-demand video streaming) should be able to reach mass market already today, although the time horizon for user adoption is less positive compared to its technological feasibility. According to the experts, technology is expected to come ahead of the market (Figure 4). While about 50 percent of the experts think that health monitoring systems are market-ready, only 25 percent estimates that there is a market for such a service at this moment. Hence, a time lag is expected between the actual possibility to enable an application from a technological stance and the time needed to reach critical mass (about 15 percent of the market). Generally, the time lag seems bigger for less popular use cases than for the most likely services – albeit that a considerable part of the experts expect health monitoring systems no sooner than within ten years.

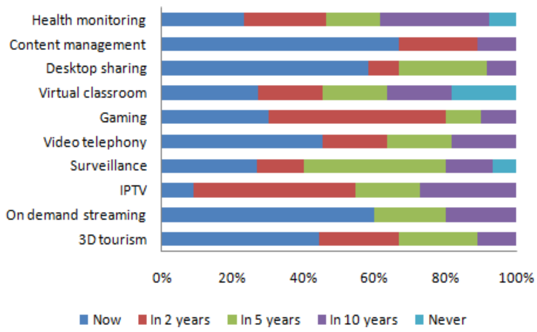

Figure 4: Time to mass market.

4.3 End-user Groups

After identifying promising services that are feasible from a technological as well as from a market-oriented perspective, experts were asked whether they believe an application is primarily a B2B or B2C scenario or both. Evidently, service providers are eager to offer services with market potential that can be used both for business and consumer purposes. In this context, applications identified as most promising are scoring rather well.

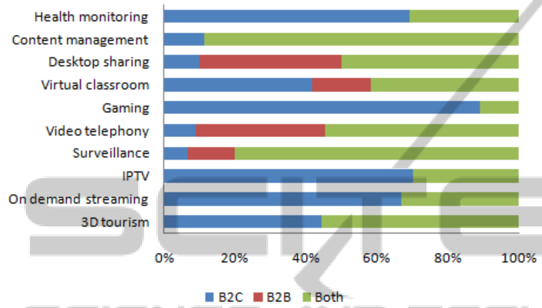

Figure 5: End-user groups.

Figure 5 clearly shows that content management applications and surveillance cameras are considered appropriate for business as well as for consumer use. Health monitoring, online gaming, internet-protocol television and on-demand video streaming are seen as applications almost only relevant for consumer markets. In contrast, video telephony and desktop sharing are identified as business applications. Apart from this analysis, most use cases can be utilised by private as well as business end-users, which holds prospects in the light of the further development of these applications. As the development of these services will be subject to economies of scale on the supply and demand side, a larger sales potential should eventually lead to a cheaper and even faster development process.

5 CONCLUSIONS

In this paper, the focus was on the identification of applications that can generate added value to fibre networks and that can convince internet users to migrate from their existing connection to high-performance broadband networks. Since new technology is often developed and deployed without even knowing user requirements, a user-oriented approach was used in this project. In contrast to the belief that demand follows supply, a user-oriented approach allows to identify what future users want, whether they are willing to pay for these services and when these services will be able to reach critical mass. As almost everything is possible from a technological perspective, service adoption is often slowed down by regulatory issues (e.g. privacy), unviable business models or products that fail to meet user requirements (pricing, features, added value, etc.). Hence, a plea is made for more interdisciplinary research on information technology looking beyond technical aspects but also taking into account economic, legal and social dimensions of new ICT applications.

The outcome of such a user-oriented approach is sometimes surprising since it may tackle taken-for-granted beliefs and provide refreshing insights that let arise new perspectives and inspiring solutions to old problems. Regarding fibre services, the literature – which is scarce – indicates video-based services as killer applications to fully benefit from fibre's higher bandwidth and speed. However, according to the experts consulted, high-quality video hardly seems convincing for end-users to switch to next-generation networks. Instead, health monitoring, content management and desktop sharing are identified as the most convincing use cases for connecting to fibre networks. In terms of time horizons, however, health monitoring lags behind as experts think its underlying technology is currently not ready while critical mass is expected within two years or at the earliest.

The findings should be considered explorative as they are only based on the views and opinions of 21 international experts. However, the results indicate which services are identified as value-added services and which create business opportunities for service providers. Thereby, the results provide valuable information for next research steps, including the construction of an end-user survey (both residential and business). Afterwards, it will be interesting to verify whether expert views correspond with end-user requirements and whether the most promising services will prove convincing to end-users.

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