SEVENTH FRAMEWORK PROGRAMME

ICT-1-1.5

Networked Media

Specific Targeted Research Project

SARACEN

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Socially Aware, collaboRative, scAlable Coding mEdia distributioN

D2.1e End – User Requirements with respect to 3D services

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Abstract:	*This document is deliverable D2.1 End-user Requirements. In this document we define the end-user requirements related to the SARACEN platform, as well as the methods used for the capturing of these requirements. The document also contains a brief analysis of the stakeholders of the project.*
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1 Executive Summary

1.1 Scope

This document contains the definition of the user requirements for the SARACEN platform. In the context of capturing the users' requirements, an identification of Stakeholders has taken place, and the corresponding results are presented in this document. Furthermore, the methods used for capturing the user requirements are presented, with emphasis given to the use of questionnaires and expert interviews. Finally, special focus has been put on user-specific 3D problems such as stereo-blindness (inability to see 3D image), popular user environments and popular user equipment, and factors affecting Quality of Experience (QoE).

1.2 Audience

This deliverable is public. It contains the results of the user requirements description as well as the capturing process used, and can be used by system designers and implementers as the basis for the provision of system specifications. The document is intended to be used as an input to the specifications process in the SARACEN project.

1.3 Summary

This deliverable presents the end-user requirements related to the SARACEN platform, which define a service platform over which distribution of multimedia streams can be supported through innovative techniques, both as regards media encoding, but also as regards media distribution. Since the designed platform incorporates State of the Art technologies from the fields of multimedia coding, multimedia distribution, network transmission and protocols, while in parallel tries to address the issue of adaptive media streaming in an integrated way that will incorporate the advantages of all adopted technologies, several techniques for capturing the end-user requirements have been used.

For this, the tools used consist of:

1. Stakeholders' analysis in order to identify the different stakeholders' groups and the respective needs. For the stakeholders' analysis, the experts of the project consortium were asked to compile an internal report that has been promoted to a section of this deliverable identifying the possible stakeholders and their needs.
2. Experts' Interviews. Experts' interviews were conducted both among experts from the participant partners (which fully cover the scientific and technical fields addressed by the platform), but also using communication with external experts (i.e. W3C). All interviews were based on semi structured questionnaires, setting the framework of the questions and allowing the experts to freely express their opinion on the subjects.
3. End-user questionnaire based survey. A special questionnaire fully covering issues like the use of technologies and internet, viewing habits, user interfaces, cost deployment, personalisation, privacy, service provision and quality of service has been compiled and implemented in a web questionnaire survey, the results of which were compiled and presented in the deliverable
4. Study of the literature and related technical documentation. Here, extra information regarding trends and technical issues were used in order to complete the task of requirements capturing with knowledge and expertise found in the global literature.

The data collected has been analysed and the results are presented in the following sections of the deliverable.

1.4 Structure

The deliverable is structured in eight sections, which are described below:

Section 1 contains all the basic information concerning the content of the deliverable, in a comprehensive way.

Section 2 is an introductory section covering the need for user requirements capture and analysis. After a general presentation of user requirements analysis methodological issues, the section concludes with the general methodology framework selected for user requirements analysis in the project.

Section 3 provides a brief report on the core technologies of the project (including 3DTV and 3D video), taking into account state of the art in each field. This section has been used as a common reference point for the different experts of the project as regards the technologies that will be deployed for the provision of the final platform.

Section 4 follows with the presentation of the stakeholders in the SARACEN project. SARACEN stakeholders are grouped in six major categories: 2D/3D content producers, content aggregators, social networks, Internet content distributors, infrastructures and services, prosumers (content producers and/or consumers) and individuals. The characteristics of each group are presented in detail, analysing their role as stakeholders in the project, as well as the reasons and the way through which they are related to it.

Section 5 presents in detail the methodology used to gather users' requirements. This includes the use of a bilingual (English and Greek) web-based survey disseminated through the project partners, together with the results and the corresponding analysis.

Section 6 presents the results of the experts' interviews. These are based on a list of specific questions designed to support semi-structured interviews. Experts were asked to provide their opinion on specific issues related to the technological and scientific developments considered by the project.

Section 7 contains the results from extra input requested by experts on particular subjects like P2P, cost and 3D devices.

Section 8 concludes the user requirements process. Here we present a clear set of requirements in the form of a list combining the findings from the previous sections. We expect these requirements to help develop the specification phases of the project.

Section 9 contains the bibliography and references.

Section 10 which is the last section of the deliverable contains the ANNEXES, which include information and documentation used in the compilation of this deliverable.

It should be noted that throughout the document, wherever findings or conclusions are reported, a corresponding green color text box with a summary of the results of the related subsection is displayed in order to assist the reader to identify them and read through the text more easily.

2 Introduction

2.1 User requirements analysis phases

User requirements are generally identified throughout the phases of an iterative 'User Requirements Analysis' process. The general phases of this process are the following:

- Data gathering activities: these are the activities carried out throughout the process which relate to the collection of data associated with the user requirements. Data comes from various sources using various tools.
- Data analysis activities: these are the activities carried out throughout the process which relate to the analysis of the collected data. They allow general conclusions about the user needs and requirements to be made.
- Expression as 'requirements': these are the activities carried out throughout the process in order to translate the general conclusions made about user needs and requirements into a set of system-oriented user requirements. They allow the technical system developers to understand user needs and will be used to support system design.
- All processes are iterative: at any point, a single phase or all phases can be repeated, in order to validate the results and fine-tune the user requirements.

The methodology described above has been followed in the production of this deliverable. In order to achieve the above targets, a list of guidelines for providing a good user analysis is presented below:

Guidelines for good user requirements analysis [Dzida]

- Focus on identifying the stakeholders' needs
- Involve all the stakeholder groups
- Involve more than one representative from each stakeholder group
- Use a combination of data gathering techniques
- Support the process with props such as prototypes and task descriptions
- Run a pilot session

2.2 Extracting End-user Requirements for SARACEN

In order to define the SARACEN platform's End-user Requirements it is essential to correctly identify and categorise the users of the system and the services provided. This has been the starting point for the system requirements analysis, which should ensure the definition of a system which covers the user requirements. For this, prior to the use of tools for capturing the end-user requirements, a stakeholders' analysis has been performed and is presented in this deliverable.

On top of that, taking into account that the SARACEN project is supported by a well-balanced consortium, covering Universities (KOC, QMUL), Research Institutions (ICCS, INOV), Industry Companies (ATOS, NTV, PrimeTel) and Organizations / Associations (CTVC, Kendra), the use of experts' knowledge on issues regarding requirements has also been exploited. Regarding the use of experts' knowledge, both interviews with experts allowing them to freely express their opinion on the platform as regards requirements, but also focused answers on particular issues were used. The corresponding results are reported in the related sections and are summarised in the concluding requirements table at the end of the document.

The carefully selected mixture of partners – enabling collaboration among educational and research institutions, industry companies and organizations – gives the project the opportunity of viewing all the issues of the project from many aspects and points of view. SARACEN will use the in-sight knowledge of these partners, combined with the experts' interviews and literature study to extract the requirements that best fit the users' needs.

The results of this, in combination with those from the survey tools are presented in the rest of this deliverable.

2.3 Data collection methodologies used

User requirements are generally related to the collection and analysis of data. The reasons behind this are:

- Requirements arise from understanding users' needs: information about user needs has to be collected in some form, in order to be analysed.
- Requirements can be justified and related to data: the definition of user requirements can be justified if it is related to a set of data that has been collected and supports this definition.

For this purpose, the data collection methods used in this deliverable – which were selected from the generally used methods [Sharp], [ESA] - are the following:

- **Studying documentation**

This is a useful process for identifying user requirements, as there are several principles, procedures and rules recorded in existing literature and documentation. Documentation is a good source of data mining about the steps involved in an activity, and of any regulations governing a task. This method should not be used in isolation but only in combination with others. Nevertheless, it is a good method for understanding legislation and getting background information, and it requires no users' stakeholder time, which is a limiting factor in the other techniques.

- **Questionnaires**

Questionnaires generally include a series of questions designed to elicit specific information. They may require different kinds of answers (such as simple YES/NO; choice of pre-supplied answers, comments). Questionnaires are often used in conjunction with other techniques. They can give quantitative or qualitative data, and they are suitable for answering specific questions from a large, dispersed group of people.

- **Experts' Interviews**

These interviews could be characterised as a forum between experts, for discussing issues regarding requirements. Interviews can be structured, unstructured or semi-structured. Several types of supportive material can be used in interviews, such as sample scenarios of use or prototypes. They are good for exploring issues, but they should be restricted to a small number of expert users, since they are time consuming and it may not be feasible to visit and interview too many members of a target group.

Finally, it should be noted that in order to complete the users' requirements, a final section before the presentation of results was included. Here, experts were asked to provide feedback on requirements for particular issues, as well as questions that are interesting for the review, based on their **real world experience and the use of standards.**

3 Summary report on core project technologies

In order to make the user requirements capturing process easier to understand, a brief report on core technologies (taking into account state–of-the-art in each field) is provided. This section has also been used as a common reference point for the different experts on the project regarding the technologies that will be deployed for the provision of the final platform. This was stated as necessary due to the diverse expertise fields, ranging from multimedia coding to low level networking. The results are reported in this section of the deliverable. However, it should be noted that a comprehensive evaluation and report of the corresponding technologies regarding "media distribution over the internet using P2P", and "adaptive content techniques", has been performed and resulted in the preparation of two white papers. The titles of these papers (provisional, as at the time of compilation of this document the final versions and titles were not available) are: "White paper on adaptive streaming", "White paper on multimedia distribution over p2p".

3.1 Peer to Peer networks (P2P)

The term "P2P network" is used to describe any distributed network architecture with the following characteristics:

- A network consisting of peer or hierarchical nodes that could contribute resources like disk storage, network bandwidth, data or even processing power directly to any other network peer, without the need of any central coordination-(in contrast with the traditional client–server modeled networks where only servers supply and clients consume).
- A network typically conformed dynamically by ad-hoc nodes in order to establish communication between them for services like file sharing, chatting etc.
- An 'ad-hoc' network where the addition or removal of nodes has no significant impact on the topology or performance network. This is due to the distributed architecture of the P2P systems, which is based on a scalable approach, while at the same time utilises service robustness algorithms, like distributed hash table indexers.

Initially P2P was used to create file sharing networks which have inspired new structures and philosophies. These networks were popularised by file sharing systems, from Napster to GNUtella, and led to the state of the art Bit Torrent.

The functionality of P2P networks is based on an Application Layer which overlays the network layer (Layer 3). This in turn sits on top of link-layer and physical layer. This architecture provides the main functions for indexing and peer discovery. The data between the nodes is transferred directly using the underlying Internet Protocol (IP) network, as P2P systems could implement extra routing layers in order to avoid the identification of the source or destination of queries. One of the most significant advantages of P2P networks is that their distributed nature increases the robustness and the ability to find and transfer data directly among the peers, without making triangular routes with centralised indexing servers.

The explosive growth of peer to peer application use has lead to more than 70% of the ISP traffic being attributed to P2P applications [PandoNetworks]. In order to ensure that network capacity remains available to provide adequate QoS for other services and more specifically for real-time like VoIP, ISP's have introduced some network policies like throttling or firewall solutions. This introduces problems as the bandwidth capabilities of the P2P nodes are significantly restricted. The conventional method to face this problem is the encryption of the IP packets but this creates an overhead which in the case of multimedia streaming leads to additional packet processing time and therefore has to be avoided. Thus an innovative mechanism has to be developed for this QoS limitation.

3.2 Scalable Video Coding (SVC)

Scalable video coding (SVC) [Schwarz] [Ahmad] [Wien] [AdamiSVC] [Mrak] schemes offer an efficient alternative to simulcast encoding for applications where content has to be transmitted to many non-homogeneous clients with different decoding and display capabilities. Moreover, the bit-rate adaptability

inherent in the scalable codec designs provides a natural and efficient way to adapt content according to changes in network conditions.

In general, a scalable video sequence can be adapted in three dimensions, namely temporal, spatial, and quality dimensions, by inserting/leaving out parts of the encoded representation, thus increasing/reducing the bit-rate and video quality during transmission. We define these dimensions of scalability as follows [Schwarz]:

- Temporal scalability refers to the possibility of reducing the temporal resolution of the encoded video directly from the compressed bit-stream, i.e. number of frames contained in one second of the video.
- Spatial scalability refers to the possibility of reducing the spatial resolution of the encoded video directly from the compressed bit-stream, i.e. number of pixels per spatial region in a video frame.
- Quality scalability, (commonly referred to as signal-to-noise ratio (SNR) scalability or fidelity scalability) refers to the possibility of reducing the quality of the encoded video. This is achieved by extraction and decoding of coarsely quantised pixels from the compressed bit-stream.

The SVC scheme gives flexibility and adaptability of video transmission over resource-constrained networks in such a way that, by adjusting one or more of the scalability options, it can select a layer of an appropriate combination of the temporal, spatial and quality parameters according to the current network condition.

The subjective quality of the sequences produced by a scalable video encoder may highly depend on the algorithms used for encoding. Consequently, the performance of an encoder may change significantly over diverse types of content and bit-rate conditions. Therefore, we employ two different scalable video codecs, namely, H.264/SVC [Schwarz] [Wien] and wavelet-based SVC (W-SVC) [AdamiSOTA] [Mrak], in order to investigate the effect of the encoding scheme of SVC on the perceived quality. In this section, the two scalable video codecs are briefly described.

3.3 Scalable Extension of H.264/AVC

The latest video coding standard, H.264 / MPEG-4 AVC provides a fully scalable extension: H.264/SVC, which achieves significant compression gain and complexity reduction when scalability is sought, compared to the previous video coding standards [Schwarz]. H.264/SVC reuses the key features of H.264/AVC and also uses some other new techniques to provide scalabilities and to improve coding efficiency as well. H.264/SVC provides temporal, spatial and quality scalability with a low increase of bit-rate relative to the single layer H.264/AVC. The scalable bit-stream is organised into a base layer and one or several enhancement layers. Temporal scalability can be enabled by using hierarchical prediction structures. Spatial scalability is achieved using the multi-layer coding approach. Each layer corresponds to a supported spatial resolution. Within each spatial layer, single-layer coding techniques are employed. Moreover, inter-layer prediction mechanisms are utilised to further improve the coding efficiency. Quality scalability is provided using the coarse-grain quality scalability (CGS) and medium-grain quality scalability (MGS). CGS is achieved by requantizating the residual signal in the enhancement layer, while MGS is enabled by distributing the transform coefficients of a slice. All these three scalabilities can be combined into one scalable bit-stream that allows the extraction of different operation points of the video.

3.4 Wavelet-based Scalable Video Coding

Although a hybrid based technology was chosen for standardisation within MPEG, a great amount of research continued also on W-SVC. Several recent W-SVC systems [Mrak] have shown a very good performance in different types of application scenarios, especially when fine granular quality scalability is required. First, the input video is subjected to a Spatio-Temporal (ST) decomposition, which is based on wavelet transform. The purpose of the decomposition is to decorrelate the input video content and provide the basis for spatial and temporal scalability. The ST decomposition results in two distinctive types of data: wavelet coefficients representing the texture information remaining after the wavelet transform, and motion information (obtained from Motion Estimation (ME)), which describe spatial displacements between blocks in neighbouring frames. Although generally, the wavelet transform performs

very well in the task of video content decorrelation, some amount of redundancies still remains between the wavelet coefficients after the decomposition. Moreover a strong correlation also exists between motion vectors. For these reasons, further compression of the texture and motion vectors is performed. Texture coding is performed in conjunction with so-called embedded quantisation (bit-plane coding) in order to provide the basis for quality scalability. Finally, the resulting data are mapped into the scalable stream in bit-stream organisation module, which creates a layered representation of the compressed data. This layered representation provides the basis for low-complexity adaptation of the compressed bit-steam.

3.5 DCCP

The Datagram congestion control protocol DCCP [RFC4340] is a recently standardised protocol filling the gap between TCP and UDP protocols. Actually it is a hybrid transfer protocol by combining the features of legacy protocols like TCP and UDP. More specifically, unlike TCP, it does not support reliable data delivery and unlike UDP, it provides a TCP-friendly congestion control mechanism in order to behave in a fair manner competing with other TCP flows. DCCP includes multiple congestion control algorithms which can be selected according to the user QoS requirements. DCCP identifies a congestion control algorithm through its Congestion Control ID (CCID). To date three CCIDs have been standardised by the Internet Engineering Task Force (IETF).

The purpose of using the DCCP is its ability to better handle multimedia streaming traffic and its provision of a degree of transmission control for real time traffic that it is not provided by UDP. For example, the increasing deployment of wireless networks like mobile and satellite, which have different transmission characteristics regarding delay and errors when compared to fixed networks, poses a question about suitability of new protocols like DCCP for use in those networks. As the performance of TCP over heterogeneous network infrastructures like terrestrial, satellite and wireless links has been extensively evaluated with a number of proposed protocol enhancements [Balakrishnan 1996], [Marcondes 2006], it is likely that any TCP-like or TCP-friendly DCCP algorithms will also have performance difficulties in these networks.

DCCP could be used within SARACEN as a packet stream transport protocol of the selected P2P platform and application by combining TCP features like congestion control and the advantage of flow based semantics without adopting other TCP features like orderliness and strict reliability. One of the primary goals of DCCP was to face up the congestion control in the transport layer. This helps to removing the necessity for congestion control in the application layer as is the case of UDP. Additionally, all the applications which would use DCCP will have the same standard congestion control mechanism. As another positive point, DCCP will nicely collaborate with the other existing congestion controlled transport protocol in the network like TCP.

Additionally, the RFC4342 provides a proficient and detailed outline on how TFRC can be incorporated into DCCP. TFRC is basically a receiver-based mechanism, where the sender's transmission rate is purely guided by the feedback with TCP traffic sent to the receiver. The receiver provides feedback to the transmitter via control packets which contain two measured parameters: round trip time (RTT) and the loss event rate.

3.6 3DTV and 3D Video

The common introduction of the 3D content to cinemas and home television is the current revolution in the production and delivery of multimedia. In a strong competitive environment, where multiple applications and equipment deliver similar functionalities, the key to success is to provide users with the highest possible viewing experience.

3D is based on the way human brain and eyes work. The pupils of human eyes are about 6.5 cm (appr. 2.5") apart, so each eye views a scene from a different angle and generates a unique image. The brain merges the images to create a single picture. The slight difference between the image from the right eye and the image from the left eye allows the brain to judge the depth. Stereoscopic vision is attained.

When a person is looking at photographs or watching television in 2D, each eye gathers essentially the same information. In other words, due to the fact that the image has no real depth, there is only one

way of viewing it. If there is any 3D impression at all, it comes from visual clues in the image, such as perspective.

Following this reasoning, the goal of 3D displays is to get a distinct image into each viewer's eye. From that point, the viewer's brain takes over; processing each image in the same, natural way in which it processes the images it receives from the three-dimensional world. A characteristic common to all 3D displays is the creation and display of more than one view of a scene. Still, viewers have to wear special glasses to discern the views. In the last few years, research teams and companies are developing auto-stereoscopic 3D displays (displays that do not require users to wear special 3D glasses), but it will need some years more to be introduced in the common market.

3DTV is a new step in the progress of the consumer television. It gives to the end user the ability to feel and be a consumer of new kind of content and to the producers – a new and novel tool for content creation. Evolution from HDTV to 3DTV is a step, which is at least as significant as from SDTV to HDTV.

4 SARACEN Stakeholders

In order to understand and define SARACEN stakeholders, we have analysed both the technologies involved and the main players in the industry trying to determine how the players will interact within the foreseen SARACEN environment.

Therefore, our approach to determine the SARACEN stakeholders has been to list the types of organisations required from a technical point of view and from industry. It is our understanding that Internet and cloud technologies are increasingly becoming of great importance to the media industry. The following picture shows a basic summary of Gartner's view [Gartner]:

Figure 1: Gartner's Media Cloud Services today's view

Under Gartner's view for cloud media there are three main categories with different roles in relation to Enterprise Applications; Consumer Portals, Infrastructure Services and Application Platforms.

In order to understand SARACEN stakeholders, we consider that this approach, although being much related, is not enough to understand our vision.

In order to fully understand the requirements of the SARACEN solution, we have developed a list of the main stakeholders and defined them in basic terms.

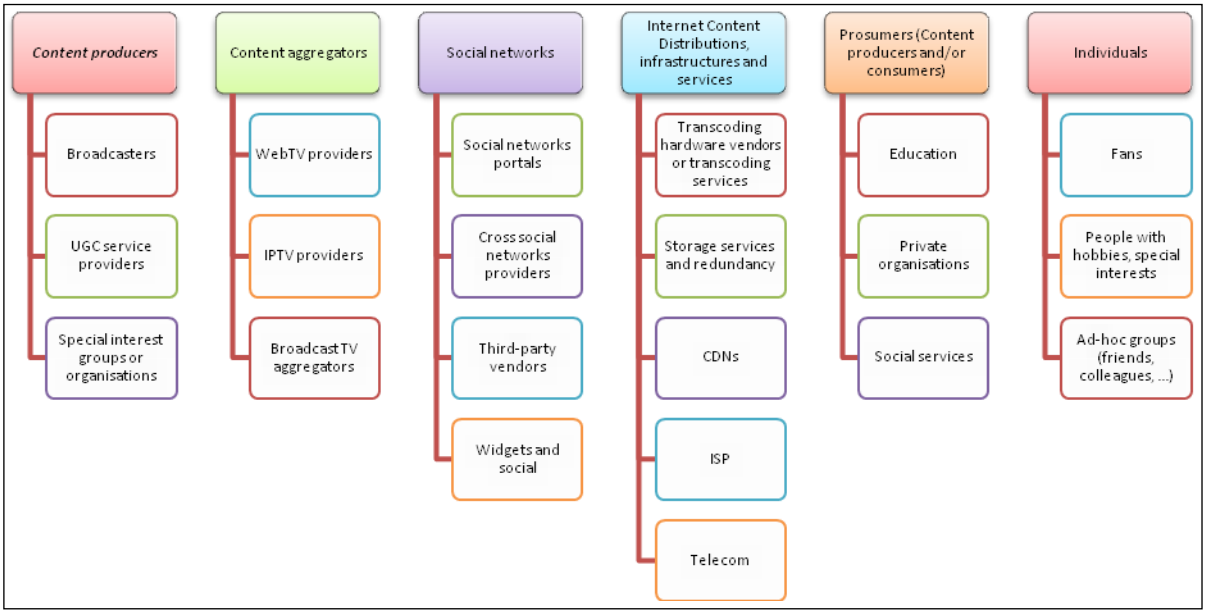

Figure 2: Stakeholders overview

4.1 Content producers

First we have grouped together the stakeholders who are responsible for actually producing content. This category contains actors with a varying profiles and natures. We have broken down this category into several subcategories, where each one has its own motivation for content generation. These are not always linked to revenues and therefore the business and service models diverge among them.

4.1.1 Broadcasters

Traditional broadcasters probably now account for the largest part of audiovisual content production, although much of the broadcast content is initially generated by third parties. In any case, broadcasters produce a tremendous amount of audiovisual content of which a significant amount is broadcast.

Broadcasters provide content not only over broadcast and content aggregation providers but also on the Internet. However most of this content is designed for television and sometimes does not match the characteristics of Internet.

In general terms, broadcast content is professionally edited to a high quality and designed for mass audience rather than niches; although small local broadcasters narrow their target audience.

More and more 3D content is now available for end-users through IPTV and satellite channels – broadcasters start to compete on this field, so the number of customers of 3D displays and home theatres increases. This works also vice versa – the growing number of customers stimulates 3DTV investments. As a result, technology is continuously improving .That is why it is expected that all these efforts will propel 3DTV growth by a spectacular 463 percent to reach 23,4 million units in 2011 (according to IHS iSuppli) [ISUP]. Another forecast, provided by Cisco® called Cisco® Visual Networking Index (VNI) [CISC], states that CARG coefficient for IP traffic generated by traditional commercial TV services is equal to 137% in 2010–2015. This traffic remains within the footprint of a single service provider, so it is not considered Internet traffic.Nowadays, European television networks offer 3D TV broadcast services. British Sky Broadcasting (Sky) launched a limited 3D TV broadcast service on April 3, 2010. Sky 3D broadcast was transmitted from Astra 2A satellite. It was a selection of live football matches from national league to British pubs and clubs equipped with Sky proprietary stuff (Sky + HS Digi-box) and 3D Ready TVs. Now offer is being expanded to include a selection of films, sport and entertainment programming. French pay-tv operator Canal+ launched 3D TV also in 2010 to present live transmissions and replays of World cup 2010 football matches. Actually, shows its own productions, premieres and replay their programs in 1080p resolution increase in broadcasting hours with increasing amount of

available content. Access is possible via satellite, IPTV and cable – recently also in Europe. In November 2010, the Astra 3B satellite launched free-to-air Brava3D channel, available in the form of unencoded devoted culture events, opera, ballet and classical music. There are also some sports channels, which are broadcasted as 3D TV (i.e. ESPN 3D and Euro-sport 3D).

4.1.2 UGC service providers

In this category we do not include those who actually generate content (end-users). Instead we focus on the organisations and/or services of those who provide support for User Generated Content (or consumer-generated media (CGM) or user-created content (UCC)).

Within the UGC service providers, we have included those organisations providing a combination of the following services:

- Widget providers
- Content edition, aggregation, storage service providers
- Content storage providers
- Coding service providers

UGC historically means internet users uploading non-professionally made films or short clips of video to online repositories run by UGC service providers. Increasingly these clips are coming from handheld portable media devices such as mobile phones or from a new generation of small, high quality video cameras such as “Flip” cameras. The next level is to expand user’s creativity by giving them access to a range of tools offering simple, online manipulation of HD images and video, and more complex professional editing tools.

Traditional issues which have held back development of such tools include low bandwidth internet connections, unreliable connections and poor upload/download speeds which make editing tasks slow and laborious. However recently, with increased internet speeds and improved quality of connections, this environment is changing. Consumer take-up of UGC services is increasing and users are looking for the same QoE from video streaming services as they get from playing media directly from recording devices through their HDTV’s.

For UGC service providers, the availability of practically infinite metadata within content aware networks will play a vital role in the future. First of all, it enables content to be found more easily as material is catalogued in improved ways meaning search terms will return more relevant results. Second, with content aware networks it would be ensured that only the closest and best quality content is being streamed to the end-user.

These features will improve QoE for end-users and the UGC service providers which are looking to retain and increase their market share in a competitive market.

The following list provides a basic reference of UGC services that allow end-users to edit their audio visual content:

- Truetube (http://www.truetube.co.uk)
- Kaltura (http://corp.kaltura.com)
- Pixorial (http://www.pixorial.com)
- JayCut (http://community.jaycut.es)
- Movavi (http://online.movavi.com)
- Zamzar (http://zamzar.com)
- Cellsea (http://www.cellsea.com)
- Graffiti Vidavee (http://grafiti.vidavee.com)
- Media Convert (http://media-convert.com)

Figure 3: UGC services allowing end-users to edit their audio visual content

4.1.3 Special interest groups or organisations

This is a burgeoning market. As we know, web speeds are increasing and viewers are increasingly consuming media via web channels instead of traditional DVD and satellite/cable/terrestrial TV sources. Here their needs can be met in a medium which they realise that it has few boundaries and where they can find the high quality content they need exactly when they need it, rather than settling for content that is similar to what they need, and only broadcast when the broadcaster wants to schedule it, or content on DVD which they have had to pay for and wait to be delivered or collected.

Increased QoS and QoE through stable streaming of High Definition video means niche markets that will be particularly well catered for organisations such as CTVC's "TrueTube", are increasingly basing their business models on producing web-based content for specific audiences – in this case for teachers to engage students in the discussion of serious topics in the classroom. Different organisations target different age groups, but the overall result is the same: an increase in the amount of professionally produced, high quality specialist video and animation content is becoming available to special interest markets.

The SARACEN platform is of particular interest for a number of independent media producers and consumers. Given the explosive growth of viral video distribution via niche social networks and ad-hoc Internet communities in the past few years, a P2P-based infrastructure which is resilient to censorship and network constraints is an especially viable means of expression and promotion for a number of special interest groups and independent organizations. For those groups or individuals without easy access to large-scale content distribution networks for economic, technical, or political reasons there is a clear benefit to the use of a P2P distribution chain. Some examples of interested parties who have been using social networks and independent online video distribution to great advantage include:

- Citizen journalists and live-bloggers
- Customer review and advocacy sites
- Niche discussion boards, especially those focused on specific topics of interest
- Independent news agencies

4.1.4 Video artist

As a video artist in the SARACEN project we can consider anyone who captures a video in order to distribute it on the SARACEN platform. This includes people who will capture a video using devices varying

from a simple mobile to a high definition camera.

The ongoing development of new video technologies for production, post-production, distribution and display is really outstanding. Consider the changes we have seen in the last five years alone. First, HD cameras at all levels (broadcast, prosumer, and consumer) are much cheaper and therefore more widespread. Second, we have increased ability to manipulate these images in post-production. It is certain that video artists will use these production and post-production tools to push the limits of the moving image in a wide variety of directions - including the exploration of purely visual slow forms of video expression.

4.2 Content aggregators

A content aggregator is an individual or organization that obtains the rights from multiple content providers to resell and distribute content through other communication channels. A content aggregator typically receives and reformats media content, stores or forwards the media content, controls and/or encodes the media for security purposes, accounts for the delivery of media and distributes the media to the systems that sell and provide the media to customers. [IPTVmagazine]

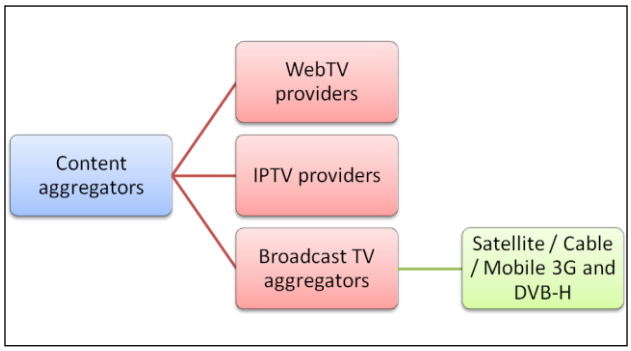

Figure 4: Content aggregators

4.2.1 WebTV providers

The arrival of high speed internet connections has enabled the birth of a range of WebTV providers. SeeSaw.com in the UK is a representative example. Having completed deals with several of the main broadcasters in the UK and USA, SeeSaw are now offering a growing catalogue of popular historical and current television series to stream for free, or for a small fee – 99p per episode or £17.99 to “rent” a whole series.

For such service providers, the ability to stream and scale HD content to televisions, set top boxes, handheld devices and computers is vital to the development of their business models. At the same time, fickle, fast fingered viewers are increasingly rejecting low quality video materials so service providers must strive to increase viewer QoE.

Looking forward, higher speed networks are rolling out across the world – much of Europe already has 100mb broadband, but the UK is lagging far behind, with plans for a national network of high speed broadband connections still in development.

Therefore, the development of standardised codecs to allow HD content to a) travel across unsecure low-bandwidth networks and remain intact and b) be scalable to its original source resolution, is massively important if this area of commerce is to grow.

The availability of WebTV platforms is presented in the following figure [WP-IPTV]:

Service	Supporting companies	Regional availability	Website based	Windows application	Mac application	iOs support (iPhone)	Android support	Console support	TV set application	Set Top Box application
BBC iPlayer	**BBC**	**UK**	**Yes**	**Yes**	**Yes**	**Yes**	**Beeplayer**	**Wii, Xbox**	**Yes**	**Virgin Media On**

								360, PS3		Demand
Sky Player	Sky	UK	Yes	Windows Media Center plug-in	Yes	No	No	Xbox 360	No	Sky TV
MSN Video Player	Microsoft	UK	Yes	Windows Media Center plug-in	Yes	No	No	Xbox 360	No	No
Google TV	Google, Intel, Sony	Not released	No	No	No	No	Yes	No	Yes	Yes
Philips Net TV	Philips	Europe	No	No	No	No	No	No	Yes	No
Hulu	FOX, NBC Universal, ABC	US	Yes	Yes	Yes	Yes	Yes	Wii, Xbox 360, PS3	Yes	No
Internet@TV	Samsung	World-wide	No	No	No	No	No	No	Yes	No
TVCatchup	TVCatchup.Ltd	UK	Yes	Windows Media Center plug-in	Cross Platform	Yes	Pending	XBMC, PS3	Pending	Pending

Table 1: WebTV platforms availability overview

4.2.2 IPTV providers

An IPTV provider is a company which delivers television services over the Internet architecture (packet-switched network) and infrastructure. It provides an alternative way for TV signal transmission instead of traditional radio frequency broadcast, satellite signal and cable television.

The main services that an IPTV provider could provide to the end-users are live television (including local and international channels), video on demand, interactive menu, games and time-shifted programming.

In order for the end-users to be able to use IPTV services, the provider must provide them with a set-top-box to connect to a TV. The STB is responsible for decoding the delivered video stream which is usually compressed using either a MPEG-2 or a MPEG-4 codec (H.264 codec will replace MPEG-2 codec in the near future). The delivery of a video stream is achieved either via IP Multicast in case of live television or via IP Unicast in case of video on demand.

IPTV providers are able to deliver SD content and moreover HD content if the underlying network fulfils the requirements of an HD content delivery [IPTVmagazine].

4.2.3 Broadcast TV aggregators

Satellite (e.g. DVB-SH)

Satellite TV offers better picture quality to the consumer, particularly if the user is located in fringe terrestrial reception areas. Satellite TV comes in two forms, as a part of a subscription package based system or custom built by the user. One advantage with digital satellite TV is a wider range of channels; usually more than cable. Like cable, other features of satellite TV can include premium content, pay-per-view and one-way broadband Internet although the broadband Internet is separate from satellite TV broadcasters. DVB-SH – the satellite extension of DVB-H (*see next* section) can be used to provide complementary coverage to DVB-H for Mobile TV. The DVB-SH standard was approved by the DVB Project in February 2007 and by the European Telecommunications Standards Institute (ETSI) in March 2008. DVB-SH is in fact an evolution of DVB-H and the most powerful mobile broadcast standard, allowing cost-effective mobile TV deployments. It can be used in any frequency spectrum below 3GHz, including UHF, L-Band and S-Band, this in terrestrial only, satellite only or also in hybrid satellite/terrestrial network. Some massive trials have or are also to be started on DVB-SH (e.g. in the South of France, Italy, India and in the US). For example Alcatel-Lucent's promise for "unlimited Mobile TV" is

based on the open DVB-SH standard among others from the DVB family (DVB-T, DVB-H) and allows delivering high-quality mobile TV, anywhere and on any kind of mobile devices. This solution is ultimately a combination of mobile terrestrial and satellite broadcast delivery, complementing existing 3G/UMTS networks. Figure 5 below depicts the DVB-SH worldwide ecosystem.

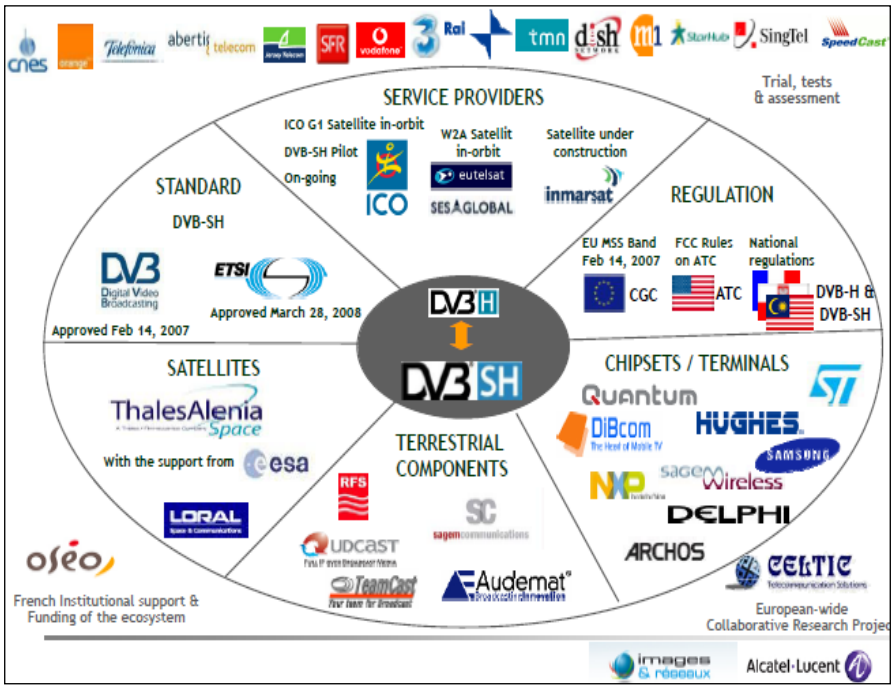

Figure 5: DVB-SH Worldwide Ecosystem [Cintel]

Cable

Cable TV is favourable in built up areas whereas Satellite TV is the only option out in the country. Cable TV and satellite TV have been competing against each other for many years now. Each one has its advantages and drawbacks over the other while both aim to offer the consumer a wider range of channels and content.

Mobile 3G and DVB-H

A 3G mobile network operator offers voice, Internet access and converged services. Mobile TV is a new channel for content providers to re-sell their existing content and allows cell phone owners to watch television on their phones from a service provider. Television data can be obtained either through an existing cellular network or a propriety network. The technological environment is going through developments in the Mobile TV Domain. Market forecasts are quite different among analysts but most of them agree on a huge market growth in the next five years. In-Stat [In-Stat] forecasts that by the end of 2010, mobile TV broadcast subscribers worldwide will reach 102 million, a giant leap from 3.4 million in 2006.

There are multiple ways to deliver TV services to mobile users. Broadcast technologies have been optimised for handheld devices and reception with small antennas (e.g. DVB-H, DVB-SH). Cellular networks can be upgraded to support cell-level broadcast and multicast of streamed video (3G+/MBMS, Wimax/MBS) in addition or combined with unicast services. Future Mobile TV services will take advantage of a combination of these delivery solutions. Abi Research has published a new market research report that forecasts that the number of global subscribers to Mobile TV services might reach 462 million by 2012, driven mainly by the expansion of 3G network deployment and flat-rate pricing plans.

Compared to IPTV, the costs of content production are low. However, handsets and service costs, setting aside subsidies, are still expensive. The mobile TV market continues to be a rapidly evolving convergence of the media, mobile communications, Internet services and consumer electronics industries. It consists of a global ecosystem of content providers and aggregators, retailers and service providers, network and device software solution providers, and network and device OEMs.

DVB-H

Digital Video Broadcast-Handheld: an extension of the DVB-T (Terrestrial) standard now being used for digital service to TV sets in Europe. Programming is fed from satellites to transmission towers, and then distributed to receiving devices. It is designed to accommodate the unique reception requirements imposed by mobile users and the limits of an antenna embedded in the handset environment. Digital video broadcasting (DVB-H), the standard used for bringing broadcast services to handheld receivers, is based on IP encapsulation over the MPEG-2 Transport Stream on the physical layers of DVB-T. DVB-H transmissions take 7 or 8 MHz of spectrum and give 5 Mbps useful payload (20 good quality video channels).

A DVB-H broadcaster is the entity transmitting the program via the DVB-H platform - the television station. By 2011, video services like downloading would be used as a sales channel for specific video content while DVB-H takes over as the primary channel for mobile video services," says Frost & Sullivan [Frost] Industry Analyst Pranab Mookken. With the full-fledged rollout of DVB-H mobile television (TV), the current role of downloaded video content (downloads and streaming) in providing access to TV and other forms of video entertainment is likely to change. Manufacturers launched DVB-H mobile TV on a trial basis by 2008 after dealing with ambiguities regarding spectrum allocation.

Meanwhile, operators are likely to deploy stopgap solutions involving multicasting technologies in addition to using existing cellular networks and video services to introduce TV in Europe. Mobile TV using DVB-H will be easy to use and will offer a better experience for its customers. This will automatically translate into increased viewership. Initially, companies will keep prices low, until business models, service offerings and quality levels become satisfactory.

The biggest beneficiaries of this development will undoubtedly be the terminal providers that will gain tremendously from the revenue influx prompted by the need for compatible handsets. Service providers, especially mobile operators, will see a rise in their average revenue per user through the deployment of value-added services in the form of DVB-H mobile TV. The channel will also help in making operators' retention and loyalty strategies more intimate and effective. "The market will drive innovation in content creation using formats, which are flexible, easier to implement and provide growth opportunities to con-

tent owners/aggregators. In addition, this technology will create a new market for the short film industry, benefiting both large as well as boutique studios." says Frost & Sullivan [Frost] Industry Analyst Pranab Mookken. With their experience in creating and aggregating content, broadcasters have a privileged role in delivering content for television services to a handheld device. In Japan, broadcasters have driven the launch of handheld television services.

However, broadcasters will need to define the level of their involvement in the DVB-H service offering. For example, will broadcasters manage the end-relationship with viewers or prefer to delegate this role to another party? And, if the second option is preferred, will broadcasters accept the packaging of their content in a third-party offer? Broadcasters may not be alone in providing services. It is possible that other players, such as mobile phone operators, may by-pass broadcasters in the delivery of television services to a handheld device. At this stage, however, broadcasters are in a strong position since DVB-H uses the broadcast spectrum to deliver broadcast services to a new type of television receiver [3gamericas].

Mobile operator

Should mobile telecom operators [Internetq] be willing to integrate their mobile telephones with a DVBH receiver, broadcasters may benefit from this partnership. Mobile telecom operators have access to a large customer database and a sophisticated payment system which can be used for customer billing.

Due to the fact that many consumers view mobile telephones as "trendy" devices and willingly change them every few years to benefit from new features or fashion, a service delivered via a combined TV/mobile phone may have a great potential for success. Mobile operators have already installed a dense network of cellular transmitter sites which may be helpful to use for the roll-out of DVB-H services. But incorporating a mobile phone into a DVB-H receiver means that mobile telecom operators will have a crucial role in the delivery of broadcast services. A logical question would be whether mobile telecom operators will want to integrate a broadcast television receiver on their handheld telephones since this may lead to a reduction in the amount of telecommunication messages sent as consumers may be encouraged to become passive television viewers.

The process is the following: First, the provider delivers the content directly to Content Aggregator or via ftp and content is organised, tagged and categorised by type. (Both automated and manual upload of content are supported). After this, content is offered to affiliates on an agreed pricing scheme. Finally, the affiliates can handle their content according to present conditions.

Web

The rise of these web-based opportunities has driven to the emergence of a new type of content provider: the web content aggregator. By reaching a broader audience through syndication opportunities, providing a wider variety of content and customization and by introducing new business models and delivery formats, this type of content provider is creating a new environment for content. At the moment, web content aggregators have created a niche for current content driven by the demand for business-to-business content on web sites. However, traditional content providers currently offer content and services that differ from the current web content aggregator business models, including more sources, archival content, user searching, brand recognition, and a wide variety of pre-packaged content options. Yet, web content aggregators have the economic relationships, infrastructure, business models and momentum that may attract many companies struggling with the content needs of intranets and portals. Web content aggregators could emerge as big winners in the online content licensing business.

Some of the key factors driving the rise of Web Content Aggregators [Infotoday] are:

- **The Demand for business-to-business content**

Web content aggregators have the infrastructure as well as the economic relationships to fill web pages that could maintain customer interest and thus fulfilling the need of many businesses.

- **Anyone can publish content for the Web**

Web-content aggregators can easily syndicate and make available good content for distribution that was not available before.

- **Traditional journalists are migrating to the New Media**

A number of traditional well experienced and well known journalists have shown interest in writing for web-based publications, being charmed from the new media, stock options, and newfound celebrity. These important personalities can significantly help with building the credibility for new Web-based publications.

- **Syndication**

Web content aggregators can also help traditional and new media content to reach a wider audience. Through a web content aggregator, lesser-known publications can be syndicated and find an appropriate audience on the web, whereas traditional media can expand their presence.

- **Variety of content formats**

Web content aggregators can help subscribers integrate formats like XML and HTML into their sites through the increase of demand that they create for these kinds of formats.

- **Broadband content**

The audio and video content availability is becoming bigger and bigger and will continue to grow until earning an important place just like the data content offerings on the web.

- **New Business Models**

Web content aggregators have the infrastructure as well the capability to enable both new and old content providers, in order to make their content free, and at the same time to help them expand their audience, while continuing to use the content licensing business model as well. Free information on the Web is an essential part of the Web content aggregator's business model.

4.3 Social networks

Social network services [WikipediaSocNetServ] exist so that people can share interests and social activities. Generally consisting of a public profile of each user with additional value-added services depending on the type of network, most social network services are web based and provide the means for users to interact over the internet, such as e-mail and instant messaging. Although online community services are sometimes considered as a social network service in a broader sense, social network service usually means an individual-centred service whereas online community services are group-centred. Social networking sites allow users to share ideas, activities, events, and interests within their individual networks.

Social networks fall mainly within the following categories:

- Social network portals
- Cross social network providers
- Third-party vendors
- Widgets and cross-network mashups

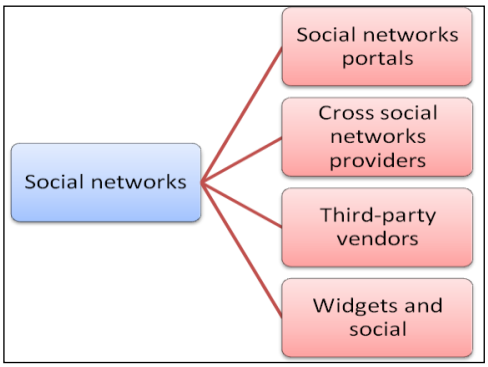

Figure 6: Overview of Social Network Categories

Top social networks in the Western Hemisphere [WikipediaSocNetList]:

1. **Facebook**. According to Facebook, there are more than 500 million active users, 50% of which log on to Facebook on any given day, with each one of them having 130 friends. As regards the time spent per month on Facebook, this reaches up to billion minutes per month [Facebook].

2. **MySpace**. According to various statistics the approximate number of users of this application in a worldwide scale is 67,625,820 unique visitors [SiteanalyticsMS].

3. **Orkut**. The latest analysis of the number of the visitors gives 694,841 unique visitors for the Orkut application [SiteanalyticsOrk].

4. **Twitter**. This social application is visited by 190 million users, according to the most recent statistics [Businessinsider].

5. **LinkedIn**. According to statistics as regards the visits received by this social application, the number of visitors rises up to 12,897,406 [SiteanalyticsLink].

6. **Bebo**. The latest analysis of the number of the visitors gives 2,105,011 unique visitors for the Bebo application [SiteanalyticsBebo].

4.4 Internet Content Distributions, infrastructures and services

In the following sections we describe the different Internet Content Distributions, infrastructures and services. They can be classified into five categories:

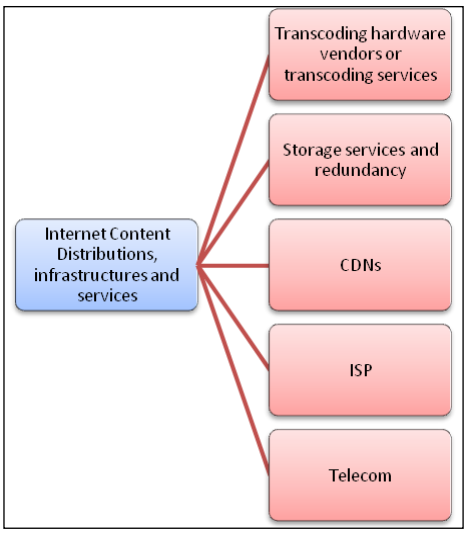

Figure 7: Overview to Internet Content Distributors and Infrastructures etc.

4.4.1 Transcoding hardware vendors or transcoding services

As the number of networks, types of devices and content representation formats increases, interoperability between different systems and different networks is becoming more important. Thus, devices such as gateways, multipoint control units, and servers must be developed to provide a seamless interaction between content creation and consumption. Transcoding of video content is one key technology to make this possible. In general, a transcoder relays video signals from a transmitter in one system to a receiver in another system (or network).

The most straightforward way to transcode from one format to another is to cascade the required decoder and encoder. This approach is known as the cascaded pixel-domain transcoder [Vetro] [Xin]. Here, the trivial transcoder is defined as the transcoder in which no intermediate processing is performed, i.e. when the sequence is simply decoded and re-encoded. However, such an approach results in high quality transcoded videos with very high complexity. A possible way to reduce the complexity is to reuse motion information from the decoded video during the re-encoding process.

Transcoding between hybrid-based video coding structures has been already extensively studied [Vetro] [Xin]; the same applies to targeting hybrid based scalable codecs [Cock]. However, hybrid-based to wavelet based scalable video transcoding has not been fully investigated in the literature. Although a hybrid based technology was chosen for standardization of scalable video coding within MPEG [AVCGAS], a great amount of research continued also on Wavelet-based Scalable Video Coding (W-SVC). Several recent W-SVC systems have shown a very good performance in different types of application scenarios [Mrak] [Andreopoulos] [AdamiSOTA], while still being able to deliver some attractive features not supported by the standard, such as Fine Grain Scalability (FGS).

Vidyo [Vidyo] which is a company founded in the US offers teleconferencing services using both hardware and software solutions. The hardware is a video aware router which uses advanced scheduling algorithms for video packets whereas the software counterpart is the teleconference software with real-time SVC encoder.

4.4.2 Storage services and redundancy

A file hosting service, online file storage provider or cyber locker is an Internet hosting service specifically designed to host static content, typically large files that are not web pages. Typically they allow web and FTP access. They can be optimised for serving many users (as is implied by the term "hosting") or be optimised for single-user storage (as is implied by the term "storage"). Related services are

video sharing, virtual storage and remote backup. Storage services also include redundancy service: they backup data once in a while to an offsite tape or disk backup system.

SugarSync

SugarSync, which has been rated as #1 online storage company in 2010 [OnlineStorage], is an online storage service. Combining powerful features, valuable plans, and overall versatility, SugarSync earned the top spot as the best online storage solution available. SugarSync is a compelling service, complete with the ability to effectively store, share, and even synchronise users' files online. Some of its standout features are the following: file synchronisation across PCs, Macs, and Smart phones, continuous, automatic, and secure service, while keeping five previous versions of each file, flexible sharing and sending options.

Amazon S3 (Simple Storage Service)

Amazon S3 provides a simple web service interface that can be used to store and retrieve any amount of data, at any time, from anywhere on the web. It gives to any developer access to the same highly scalable, reliable, secure, fast, inexpensive infrastructure that Amazon uses to run its own global network of web sites. The service aims to maximise benefits of scale and to pass those benefits on to developers. Amazon S3 provides a highly durable storage infrastructure designed for mission-critical and primary data storage. Objects are redundantly stored on multiple devices across multiple facilities in an Amazon S3 Region [Amazon].

Symantec Hosted Services

Symantec Hosted Services uses the power of cloud computing to provide essential protection while virtually eliminating the need to manage hardware and software on site. A Cloud storage service can make sense for a company with unpredictable storage demands, a need for an inexpensive storage tier or a low-cost, long-term archive. It is not a recommended choice for high-transaction databases or temporary storage [Symantec].

YouTube

YouTube is a very popular Web video sharing site that allows every user of the Web to store short videos for private or public viewing. Within a couple years, more than 25 quadrillion bytes (petabytes) of video data were being streamed from the site in a monthly basis. YouTube supports AVI, MOV and MPEG video formats from most digital cameras, camcorders and cell phones and recommends DivX or XviD (MPEG-4) at 320x240 resolution for best results. YouTube converts all uploaded videos to flash video, and users must have the Flash player installed in their computers in order to play them.

4.4.3 CDNs

(**C**ontent **D**elivery **N**etwork) [D1.1 SmoothIT] is an Internet distribution system that accelerates the delivery of Web pages, audio, video and other Internet-based content to users around the world. The CDN replicates the content provider's files in servers, called "caching servers" or "edge servers," located in geographically dispersed data centres. Most CDNs are third-party services, however large companies may develop their own "enterprise CDN" (eCDN) to support remote locations more effectively. When content is replicated throughout the country or the world, it is delivered to users with greater speed and reliability. The CDN network routes the user's request for content to the appropriate caching server based on the user's location. CDNs are often connected to multiple ISP backbones and have peering relationships with others, providing high availability to users.

CDNs are an example of an overlay network that is widely used to seamlessly bring web content closer to the end-users. As already mentioned in previous sections, Akamai is one of the leader companies in this market.

On the one side we have *Content Users (CUs)* and on the other side we have *Content Providers (CPs)*. CPs determined customers of *Content Delivery Networks (CDNs)* and can be divided in either "cost sensitive/delay insensitive" or "cost insensitive/delay sensitive" categories, depending on which is the nature of their business and type of content. Furthermore, from the underlay network side, we have the *Internet Service Providers (ISPs)* and *Internet Backbone Providers (IBPs)*. Without the presence of CDNs, content users and providers pay Internet providers (either ISPs or IBPs) for accessing the Internet and either reaching or offering content. ISPs pay IBPs in order to connect to the core Internet. When

CDNs are present, new flows of data and money occur. Content providers can either distribute their content through ISPs, CDNs or both, depending on their type, i.e. if they are cost sensitive or delay sensitive. In all cases though, providers pay ISPs, CDNs or both. IBPs treat CDNs like any other network with large asymmetric outbound traffic characteristics. A transit agreement therefore is made between them. CDNs may pay or not pay ISPs depending if they are collocated or if CDNs are accessible by the Internet through ISPs. IBPs continue to charge ISPs, as mentioned in the previous case, and ISPs continue to charge end-users. Thus, a case of double billing arises where IBPs charge CUs, CPs and CDNs for the same service (either directly or indirectly), since both CPs and CUs are charged due to IBPs' bargaining power. Hence it becomes obvious that the existence of an overlay network changes the structure of the business model and the flow of data.

As a collection of web servers distributed across multiple locations to deliver content more efficiently to users, the CDN server selected for delivering content to a specific user is typically based on a measure of network proximity. For example, the server with the fewest network hops, with the quickest response time or the smallest load is chosen. This will help scaling a web application by taking a part of the load from the service servers.

Below are descriptions of some CDN's:

Akamai

Akamai is a global platform, formed by thousands of specially equipped servers. It allows the Internet to support numerous content applications load, transactions and enriched applications, regardless of whether they are static or dynamic. Akamai is able to detect, and avoid, any potentially problematic or vulnerable points to permit optimum Web running and application liability.

InterNAP

InterNAP, an Internet solutions company, provides The Ultimate Online Experience™ by managing, delivering and distributing applications and content with 100% performance and reliability. With a global platform of data centres, managed Internet services and a content delivery network (CDN), Internap allows its customers to innovate their business, to improve service levels, and to lower the cost of IT operations.

Interlink Communications

Like IPTV and Web TV – future communication with internal and external audiences via the Internet is made by Interlink as well.

Interlink has partnered with award winning technology enablers Emojo, to provide a fully comprehensive video production and playback service designed to combine Creativity with Technology and Innovation.

4.4.4 ISP

An Internet Service Provider (ISP) [Alexandrou] [Oracle] [WikipediaISP], also known as Internet Access Provider (IAP), is the company that sits in between the Internet and a potential user of the Internet. These companies are often phone or cable companies themselves, but sometimes they are independent providers of Internet access. Of course, if they are independent vendors they still need to work with the phone and cable companies since they are the ones that have the communications infrastructure.

For users and small businesses, the most popular options for internet access include dial-up, DSL (typically Asymmetric Digital Subscriber Line, ADSL), broadband wireless, cable modem, fibre to the premises (FTTH), and Integrated Services Digital Network (ISDN) (typically basic rate interface). For customers with more demanding requirements, such as medium-to-large businesses, or other ISPs, DSL (often SHDSL or ADSL), Ethernet, Metro Ethernet, Gigabit Ethernet, Frame Relay, ISDN (BRI or PRI), ATM, satellite Internet access and synchronous optical networking (SONET) are more likely to be used.

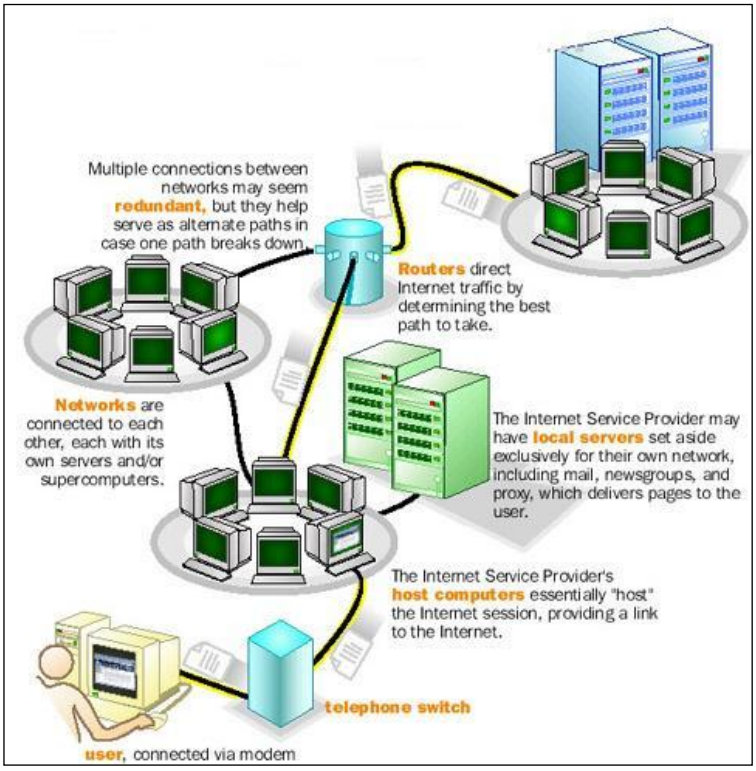

Figure 8: ISP views

ISPs may provide Internet e-mail accounts to users which allow them to communicate with one another by sending and receiving electronic messages through their ISP's servers. ISPs may provide services such as remotely storing data files on behalf of their customers, as well as other services unique to each particular ISP.

We could classify the ISP into:

- **Dialup ISPs**: Here, providers offer great value for internet access. Dial up internet provides the cheapest internet access available using your existing phone service.
- **Broadband ISPs:** High speed internet services include internet broadband from DSL providers and cable internet providers. These are the best internet providers for full multimedia internet access.
- **Satellite ISPs:** Satellites in geostationary orbits are able to relay broadband data from the satellite company to each customer. Satellite Internet is usually among the most expensive ways of gaining broadband Internet access, but in rural areas it may be the only choice other than cellular broadband. However, costs have been coming down in recent years to the point that it is becoming more competitive with other broadband options. VSAT (Very Small Aperture Terminals) networks are used for the satellite internet communication. The 11th Edition of the VSAT Report [VSATReport] lists 30 different products - but currently the star data market is primarily contested by Hughes Network Systems (with its HughesNet HN7000S, HN7700S and HX systems), Gilat Satellite Networks (with its SkyEdge II product), ViaSat (with the LinkStar and SurfBeam systems), iDirect (with the iNFINITI & Evolution) and several standards-based DVB-RCS system vendors which include Advantech Satnet, STM Group, NanoTronix and Thales Alenia Space.

AOL [Washingtonpost]

AOL Inc. formerly known as America Online is a global Internet services and media company which offers Internet telephony, email, web-site hosting, or fax services. AOL is best known for its online software suite, also called *AOL*, which allowed millions of customers around the world to access the world's largest "walled garden" online community and eventually reach out to the internet as a whole.

In 2006 AOL signed a deal with several major movie studios to open an online video store allowing users to "download to own" full length movies and television shows. The deal was signed with News Corporation's 20th Century Fox, Sony Corp.'s Sony Pictures Home Entertainment, NBC Universal's Universal Pictures, and former corporate sibling Warner Home Entertainment Group.

HughesNet (satellite ISP)

Hughes Network Systems, LLC (HUGHES) is the global leader in providing broadband satellite networks and services for large enterprises, governments, small businesses, and consumers. HughesNet® encompasses all broadband solutions and managed services from Hughes, bridging the best of satellite and terrestrial technologies. Its broadband satellite products are based on global standards approved by the TIA, ETSI and ITU standards organizations, including IPoS/DVB-S2, RSM-A and GMR-1. To date, Hughes has shipped more than 2.2 million systems to customers in over 100 countries [Hughes]

4.4.5 Telecom

A telecom carrier is a company that is authorised by regulatory agencies to operate a telecommunications system. Telecom carriers can be classified into two main groups:

- **Landline operator:** Refers to standard telephone and data communications systems that use in-ground and telephone pole cables in contrast to wireless cellular and satellite services [PcMag].
- **Mobile operators:** They are telephone companies that provide services for mobile phone subscribers. Mobile operators must have acquired a radio spectrum license from the government before they can offer mobile phone service within a country.

Telefonica / Movistar / O2

Operating globally, it is the third largest provider in the world, behind China Mobile and Vodafone. It offers landline and mobile telephony, Internet services, digital television.

Vodafone

Vodafone is a British multinational mobile network operator headquartered in Newbury, England. Vodafone Group Plc is the world's leading mobile telecommunications company, with a significant presence in Europe, the Middle East, Africa, Asia Pacific and the United States through the Company's subsidiary undertakings, joint ventures, associated undertakings and investments [Vodafone].

4.5 Prosumers (Content producers and/or consumers)

Increasingly the roles of content consumer and content producer are becoming entwined. Gradually across the Internet, User Generated Content (UGC) is becoming a larger share of the available content as amateurs create and publish their own content.

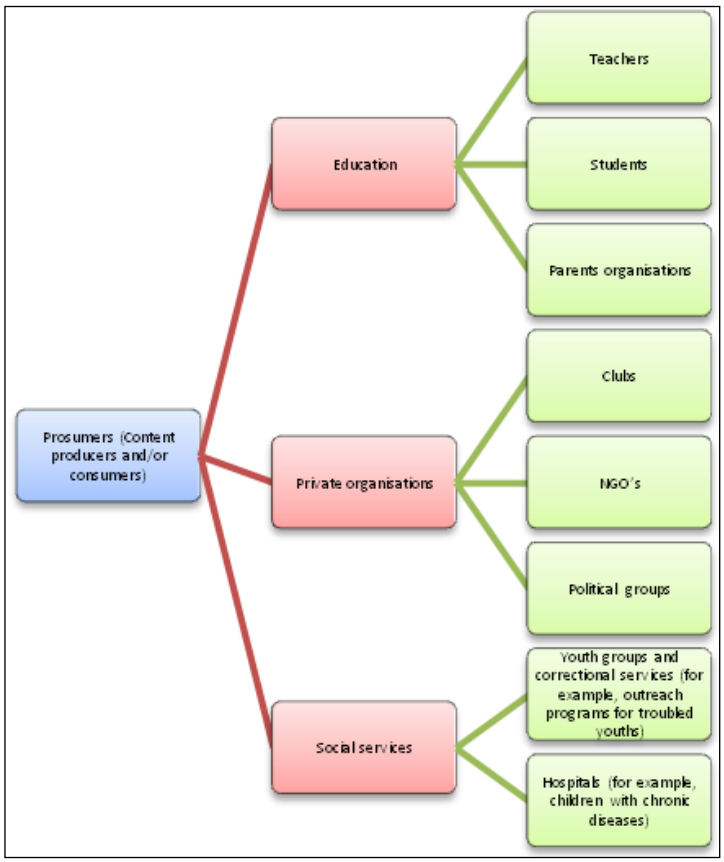

Figure 9: Prosumers

4.5.1 Education

Teachers have long used films in the classroom. They engage students and help teachers to tackle difficult subjects such as sex education which they may not feel comfortable talking about.

Recent advances in broadband technology mean that films and videos are streamed directly to students' terminals in the classroom, rather than having a class travel to a television room. But, whilst video is engaging and challenges students, simply playing video back in the classroom is not enough.

As they drop in price, consumer grade digital video, music and animation tools are becoming more popular. Giving students an assignment to create a piece of media or music on a certain topic and giving them artistic freedom to do be as creative as they like is a means through which students can understand the world from a different point of view. If they are treated as real citizens, with real, developing points of view they learn in a more realistic way.

Creative tools can also be used to document school trips – students with video phones can mash up short pieces of video with their classmates to show the highlights of their trips, and to illustrate the value of their learning to parents. Their work can also be used as coursework for examinations or to help them gain their grades.

College and university distance learning program operators

Distance learning programs are transforming higher education, bringing an enormous variety of academic programs within reach of candidates who might otherwise be prevented from attaining knowledge due to temporal, financial, or location constraints. Many accredited and non-accredited higher education institutions offer correspondence courses via Internet to interested candidates either for profit or free of charge depending on the supporting institution and desired output. Course contents, mode of examination, and duration vary widely between institutions.

There have been a number of ambitious initiatives over the course of the Internet's history to connect leading institutions for research, academia, industry and government. These have produced several outstanding not-for-profit partnerships and associations including [WikipediaNRENs]:

- DANTE (Delivery of Advanced Network Technology to Europe, established in 1993)
- CANARIE (Canadian research network, founded in 1993)
- TERENA (Trans-European Research and Education Networking Association, formed in 1994)
- GEANT (The pan-European research network, built between 2000-2004)
- Internet2 (an advanced networking consortium led by the research and education community, including over 200 higher education institutions
- DREN (U.S. Department of Defence research and engineering network)

Furthermore, P2P video distribution provides an ideal solution for distance learning course transmission, as it can reduce bandwidth and server costs for educational institutions, which often have limited technical budgets. These savings may then be passed on to end subscribers - i.e. prospective students - thereby extending the benefits of higher education beyond the physical classroom.

Teachers

University and college professors and other academic professionals have long been supportive of technical measures that improve the reach and quality of their intellectual sphere of influence. With infrastructure and support from national and international research and education networks, academics now have greater connectivity than ever before.

Utilising modern Internet technology such as Web-based VoIP, videoconferencing, live streaming, and Web chat, teachers are able to connect and interact with students on a more personal and consistent basis than with previous techniques, reducing the amount of residual administrative work and improving the consistency and quality of knowledge transfer as well as results verification (e.g. testing, scoring, and reporting).

Students

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Support groups

Support groups for parents, sufferers of various ailments, crime victims and others seeking sympathy have existed on the Internet for almost 40 years [E-Therapy-survey]. Beginning with simulated psychotherapy sessions and growing into a plethora of self-help support groups for people coping with diseases or disabilities, there are situationally oriented groups for family, personal and cultural relationships of every variation. Computer-mediated communication enables discussion of sensitive personal issues; E-mail lists, Usenet, Web chat, and various conferencing solutions provide information and emotional support to those seeking sympathy and companionship. These groups are often peer-to-peer in its most literal sense, growing organically through personal recommendations and link sharing.

4.5.2 Private Enterprises and Organizations

Clubs

Private performance spaces have an expressed interest in self-promotion through all major media. In addition to advertising and catering to various markets within multiple popular culture demographics including the entertainment and fashion industries, performance spaces may produce the following:

- live broadcast, simulcast, and archived concert performances
- streamed and archived comedy events
- live and archived sporting events
- live and archived conference and lectures
- multi-rate video streams for a variety of platforms, available for free or a fee in any of a variety formats
- market-defined resource requirements for production, distribution, archival

NGOs

A non-governmental organization (NGO) is a legally constituted organization that operates independently from any government [WikipediaNGO]. Most NGOs pursue some wider social aim that has political aspects, often involving some form of social outreach.

The number of internationally operating NGOs is estimated at 40,000, with many national numbers far exceeding that count [NGOSociety].

Political groups

A political group is defined as an organised group of people with at least more or less similar political aims and opinions, that seeks to influence public policy by getting its candidates elected to public office.

Those groups tend to be deeply and durably entrenched in specific substructures of the specific society in a sustainable and well-functioning social equality. They can associate the governmental institutions to the elements of the civil society in a free and fair society.

Standardization Bodies

The problem of accurate QoE measurement of 2D content is well defined and is still researched by numerous institutions and standardizing work groups, such as Video Quality Experts Group (VQEG). 3D introduces new and unexplored challenges.

SARACEN is involved in international cooperation in the field of science, including VQEG (Video Quality Experts Group), for topics related to 3D video streaming QoE [Jan10]. A part of the VQEG, the 3DTV Group is about to release and submit reports (to ITU-T) that will summarize the results and conclusions of the Quality experiments along with recommendations for the quality requirements for the 3DTV.

The experiments presented in the VQEG 3DTV Group reports may have significant impact on how the quality of 3DTV applications will be measured and assessed in subjective experiments in a world-wide standardised way. The final reports will summarize the results and conclusions of the analysis along with recommendations for the quality requirements for the 3DTV. The experiment results will be presented to the ITU-T for further steps in the Recommendation procedure.

4.5.3 Social services

Youth groups and correctional services

The definition of a “youth group” itself is problematic for police, policy makers, and the public. Further, the formation and composition of youth groups is influenced by such mediating factors as age, ethnicity, and socioeconomic status. The degree of organisation of correctional services and the type of activities in which members engage also tends to distinguish certain types of youth groups.

There are main objectives of correctional services organisations:

1. Develop a multidimensional conceptual framework of youth involvement in groups, including groups with connections to organised crime, etc. Factors such as the motivations to join a youth gang, recruitment tactics, organization, activities and exit strategies are considered in the development of a typology that can be utilised to better understand youth gang involvement.
2. Identify programs and services addressing issues relevant to youth groups, such as risk factors, recruitment processes, links with organised crime, and exit strategies. Key programme components sought include the geographic location of the program, the target group, the objectives and activities of the initiative, the organization facilitating the program, and its funder.
3. Categorise the programme initiatives based on their level of prevention – primary (prevention, raising awareness), secondary (intervention) or tertiary (rehabilitation, exit strategies).

Hospitals

One of the most evident results of the active involvement of public administration is children's hospitals or hospitals in general. They are involved in all the decisions and information affecting their user behaviour and the success of groups gathering users. Collaboration with them implies a better understanding of user needs in terms of accessing resources and the particularities of specific areas.

4.6 Individuals

Individuals are the biggest group of stakeholders for the platform. The sharing of media among individuals has become the #1 activity on the web, overtaking the consuming of content by adults. We have identified three categories of individuals:

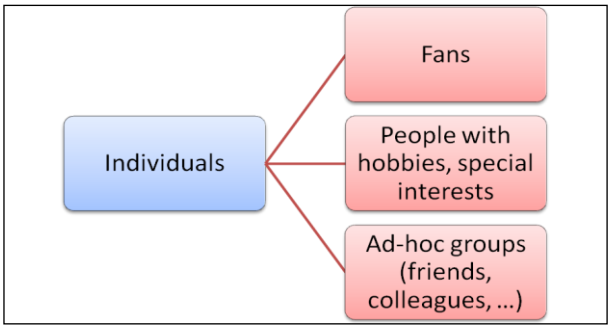


Figure 10: Identification of Individuals

- Fans
- People with hobbies, special interests
- Ad-hoc groups (friends, colleagues, location-specific associations)

5 Capturing end-user requirements

In this section, the questionnaire-based survey that was used for capturing end-user requirements is presented. The survey took place based on a bilingual electronic questionnaire that users were asked to complete anonymously. The design of the questionnaire, the specific questions and the rationale behind the selection of each question are presented, while a first level analysis of results and conclusions is provided in this section. The questionnaire is provided in Annex C at the end of the deliverable in both English and Greek, (the two languages used), while the final conclusions follow in a subsequent section. It should be noted that Prime Tel prepared a special invitation e-mail, addressed to all its subscribers (25,000 in total), inviting them to participate in the survey. This can also be found in Annex D of the document.

5.1 Questionnaire overview and general framework of the survey

The main target of the use of the questionnaire is to help in the collection of user requirements in order to develop scalable media coding techniques for media distribution, based on a personalised platform. The questions – 22 in total – are separated into 5 main categories:

- **GROUP A: Demographics/Identification (4 Questions).** Here, the demographical information of the respondents is recorded, in order to be used for extracting particular trends or results according to the status of the respondents. It should be noted that special care has been taken to preserve respondents' privacy, and that answers were provided anonymously.
- **GROUP B: Technology/Internet Experience/Usage (8 Questions).** This group consists of questions that try to capture the particular status and attitude of the respondents as regards the familiarity to and use of Internet technology.
- **GROUP C: Viewing Habits (2 Questions).** The related questions refer to the viewing habits of the respondents.
- **GROUP D: Media-quality-price (4 Questions).** The corresponding questions refer to the views of the users as regards issues of media quality and pricing of services.
- **GROUP E: Personalisation & Privacy (7 Questions).** This final group tries to capture the views of users as regards privacy preservation issues. This is important in use of social networking tools and allowing service personalization.

Where applicable, the answer format used throughout the questionnaire followed the Likert scale [Likert], since it is the most widely used scale in survey research, while allowing respondents to select a neutral answer. For this, the questionnaire was designed to include an equal number of negative and positive statements so as to avoid the problem of acquiescence bias while middle-neutral answer was available. Other problems such as central tendency bias or social desirability bias were also taken into account during the design of questionnaire statements as well as during the analysis of results. Some of the questions were mandatory, and the implementation of the survey has been formed in such a way that the user could not continue to the next group of questions, unless the mandatory questions were answered. In the following, a presentation of each question is provided, accompanied by a short analysis including the rationale and objective of the question, the presentation of the corresponding results, and some initial corresponding conclusions drawn.

5.2 Tools used

- A web-based survey was installed on Kendra's server. In this questionnaire an attempt was made to explain the difficult technical issues in order to make them understandable to non-expert users. The survey was available at the following URL: http://survey.kendra.org.uk/node/add/saracen-survey/0, while screenshots of the web pages can be found in Annex C of the deliverable. In this direction, two videos were attached in the questionnaire; one video for Scalable Video Coding, showing in practice the difference before and after the use of this technology and one for Media Tagging, showing the possibilities given to the user to enhance videos with extra material.

- All partners of the project sent invitations in order to select candidates interested in answering the questionnaire.
- The survey results were exported in a CSV file, which was subsequently transformed into an Excel file, in order to process the results and derive to conclusions as regards the answers of the participants and in order to create the corresponding charts.

5.3 Questionnaire presentation and analysis

In this section of the deliverable, all questions are presented under the corresponding category, using the following format:

- **Scope and rationale**, where the reason for asking the question and the expected result as regards the identification of requirements is presented.
- **Question**, where the actual text of the question used in the questionnaire is reported.
- **Analysis of results and conclusions**, where the answers to the particular question are analysed and conclusions in terms of mapping the answers to requirements are given.

The total number of answered questionnaires collected was 228. From these, 182 participants completed the whole questionnaire, while a detailed analysis of groups completed in total from the participants follows:

- For **GROUP A** 270 participants completed the corresponding questions completely.
- For **GROUP B** 242 participants completed the corresponding questions completely.
- For **GROUP C** 227 participants completed the corresponding questions completely.
- For **GROUP D** 213 participants completed the corresponding questions completely.
- For **GROUP E** 197 participants completed the corresponding questions completely.

5.3.1 GROUP A: Demographics / Identification

Question 1: Gender of the respondents

Scope and rationale of the question

This question of the survey refers to the identification of the gender of the respondents. The question used was the following:

- *Question: Please indicate your gender*

The respondents had to select from the following two options:

  - Male
  - Female

Analysis of results and conclusions

This question was mandatory, and therefore was answered by all the participants. The results indicate that 70% percent of the respondents were men, while the rest 30% were women. The following figure contains a graphical representation of the results. Taking into account the demographics of people to whom invitations were sent, we see that the percentage of participants is in accordance to what was expected as a synthesis of the respondents group. Indicatively, Primetel's subscribers are men/women at a percentage of 65% / 35 %, while the same percentage of men/women exists for Kendra.

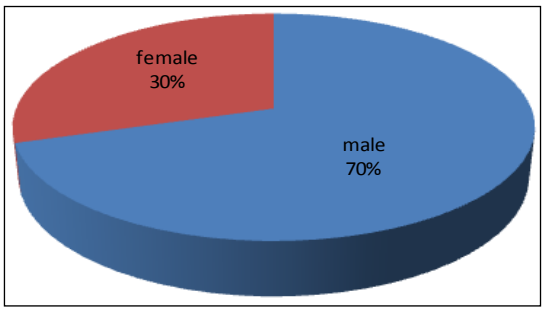


Figure 11: Gender of the respondents

Question 2: Age distribution

Scope and rationale of the question

This question aims to specify the age group in which each respondent belongs to. The age groups presented in the questionnaire were formed in order to gather ages which are expected to have the same requirements, preferences and behavior. They were also reviewed by the TV broadcasters of the project partners. The question used was the following:

- *Question: Please indicate your age (where a drop down list of the above categories was presented to the participant to choose).*

The age groups presented in the questionnaire as possible selections were the following:

- Up to 18
- 19-24
- 25-44
- 45-54
- 55-65
- Over 65

Analysis of results and conclusions

The dominant age group, as depicted in the Figure 12, is that of 25-44. In the next place in the rank we can find 18-14 (with a percentage of 14%) and 45-54 (with a percentage of 11%) age groups. The 'youngest' (age< 18) and the 'oldest' (age >55) respondents of the questionnaire follow. According to other similar collected information (such as customer segment analysis of the audience of NTV) the results appear to be the expected ones, since the major percentage of the respondents to the questionnaire is this related to ages between 15 and 44, just like the ages of the TV audience.

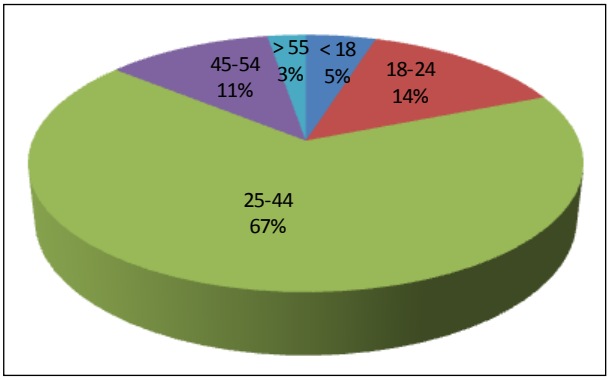


Figure 12: Age distribution

Question 3: Location of the respondents

Scope and rationale of the question

This question refers to the identification of the country of residence of the respondents. The users were able to select their country of residence from a drop-down list of countries covering the globe. The question used was the following:

- *Question: What is your current country of residence? (followed by a dropdown box for selecting the country)*

Analysis of results and conclusions

The largest number of answered questionnaires came from Cyprus; the percentage reached the 39%. Great Britain as well as Greece reached a 23%, while the percentages of answers received from other countries were well below these numbers. The results are depicted in the following picture and they are the expected ones, compared to the synthesis of the consortium.

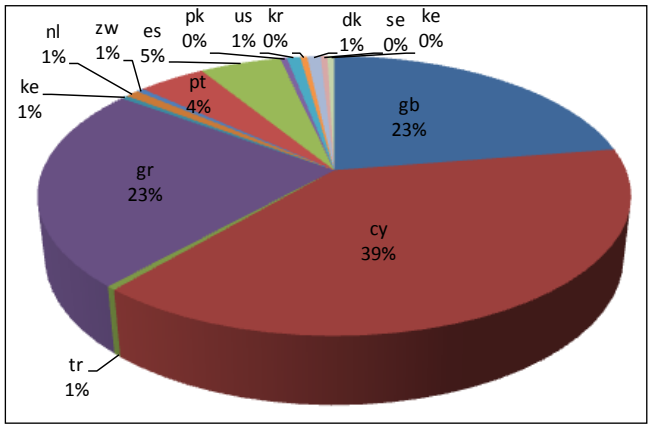


Figure 13: Location of the respondents

In detail, the partners from Cyprus (NTV and Prime-tel), representing end-users and having disseminated the questionnaire to their list of subscribers resulted to the largest numbers of answers collected. Similarly the partners from UK (Kendra and CTVC), disseminating the questionnaire to their mailing lists and representing also possible stakeholders have also resulted to the completion of a large percentage of the answers. Finally, answers from Greece are attributed to ICCS dissemination that leads the task of user requirements identification, while here it should be noted that due to the close affiliation of Greece and Cyprus, a percentage of the answers may be attributed to Cyprians living in Greece (i.e. for studies).

Question 4: Survey awareness

Scope and rationale of the question

This question aims to specify the way through which the respondents became aware of the questionnaire-based survey of the project. The question used was the following:

- *Question: How did you find out about this survey?*

The possible choices given to the respondents through a drop-down list were the following:

- E-mail message
- Web page
- Direct contact (i.e. by phone)

Analysis of results and conclusions

The most popular way through which the respondents became aware of the survey is via e-mail (more specifically through partners' electronic invitations). As we can see, the largest percentage of answers (more than 81%) indicates that e-mail has been the medium through which they were informed about the survey. Web has gathered far less responses (15%), while only 4% of the respondents chose the direct communication as an answer. The results in this question were the expected ones, as the project is still in its starting phase and the web site has not been available for a long time, so that awareness about it and inclusion in search engines has not advanced yet. This is in fact the reason that direct communication by mail has been selected also as the main means of informing the participants about the survey.

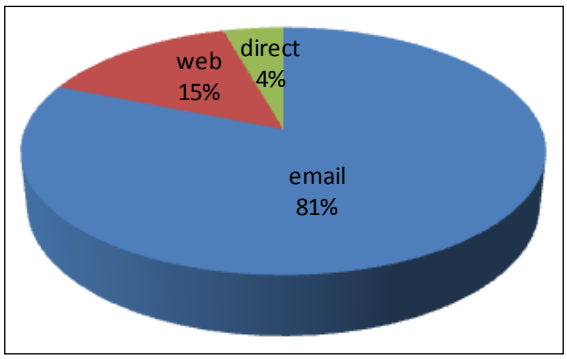


Figure 14: Survey awareness

5.3.2 GROUP B: Technology/ Internet experience/usage

Question 5: Familiarity with internet and technologies

Scope and rationale of the question

Here we have three different questions, contributing to the same goal: the identification of how familiar the user is with the use of technologies and the internet, and in particular, familiarity with:

- Internet
- Technology
- Social networking

Three different questions corresponding to the above were used for this:

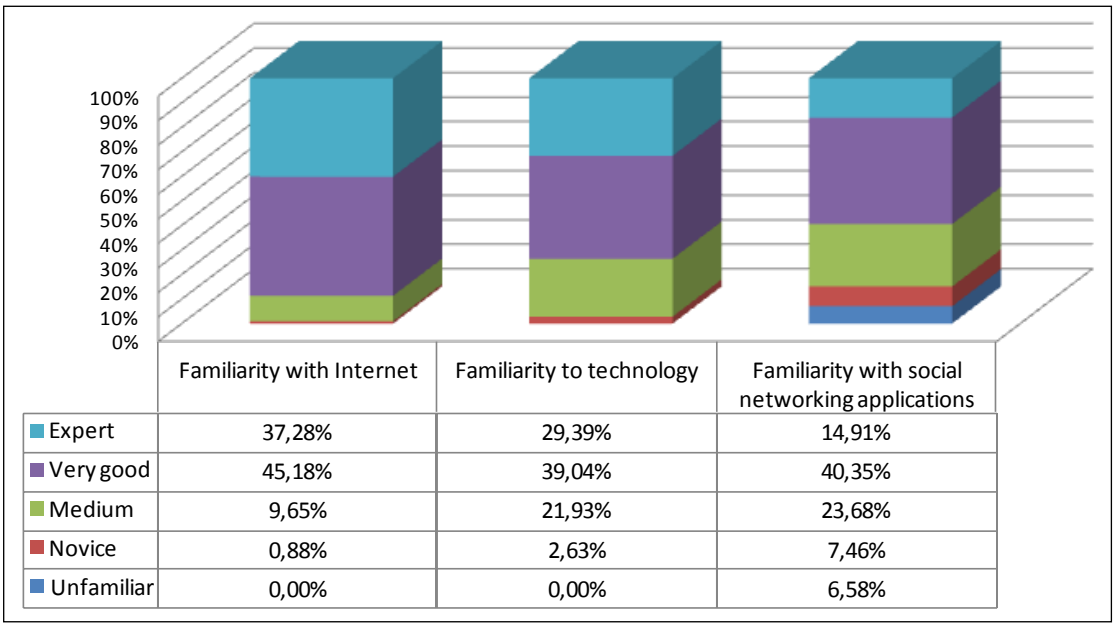
- *Question 5a: How would you characterise your experience level related to the use of internet? (the above five options were available)*
- *Question 5b: How would you characterise your experience level related to the use of Information and Communication Technology? (the above five options were available)*
- *Question 5c; How would you characterise your experience level related to the use of social networking applications (i.e. Facebook, Twitter)? (the above five options were available)*

The users were able to select among the following answers for characterising their level of familiarity to the pre mentioned areas:

- Unfamiliar
- Novice
- Medium
- Very good
- Expert

Analysis of results and conclusions

7% of the participants did not complete the full group of these questions. The rest of the participants have answered according to the results presented in the following figure. As we can see the majority of participants consider themselves as very well aware about Internet and ICT technologies, as well as the use of social networking applications. The corresponding percentages for the three categories for participants in categories Very good and expert are more than 80% for Internet, about 70% for ICT and above 55% for social networking. From the answers collected we can conclude that the participants had a good knowledge of the basic communication and computing technologies used in the project. Since in the rest of the questionnaire some questions related to State of the Art technologies for coding and distribution of multimedia are included, good knowledge of the fundamental technologies examined in this question is important, which is in fact verified.



	Familiarity with Internet	Familiarity to technology	Familiarity with social networking applications
Expert	37,28%	29,39%	14,91%
Very good	45,18%	39,04%	40,35%
Medium	9,65%	21,93%	23,68%
Novice	0,88%	2,63%	7,46%
Unfamiliar	0,00%	0,00%	6,58%

Figure 15: Familiarity with internet and technologies

Question 6: Use of social networks

Scope and rationale of the question

The scope of this question is to identify the particular implementations of Social Networks which are preferred by the users. Though a list of popularity of the social networking applications can be easily found, it is important to check if the profile of the users of the platform (and according to the demographics of the participants the answers collected are characteristic of this) have some particular preference that deviates from the general trend. The question used was the following:

- *Question: Which of the following Social Networks do you use? (all the above options were*

available, while the participant could select more than one)

The following options were available:

- Facebook
- MySpace
- YouTube
- Vox
- Bebo
- Twitter
- Linkedin
- Blogspot
- Flickr
- Friendster
- Google Buzz
- NONE
- Other (please state)

Analysis of results and conclusions

From the answers collected we see that the majority of users use Facebook and YouTube, with the two accounting for about 50% of the answers received. LinkedIn Twitter and Flickr follow with smaller percentages, while the rest of the platforms account for much smaller percentages. The percentages reported are in full compliance with the corresponding numbers of similar surveys. Therefore, we see that results from similar surveys about the general preferences of users as regards the use of social networking applications can be used. The results show a clear preference for Facebook and YouTube, with 50% of respondents using them. These are clear, simple propositions and links to these are prevalent on many social networks. Other systems do not feature as strongly, possibly because they focus more heavily on encouraging users to upload and/or contribute in some way. Blogspot is a good example as it requires writing skills, and time to spend crafting an article - correspondingly only 6% of our survey said they had a Blogspot account. This is indicative of CTVC research and strategy to pursue space on existing, successful social networks to fulfil their creation of a new more focused offering for education and youth.

As regards the social networking aspects of the platform, compatibility and experience from Youtube and Facebook should be used.

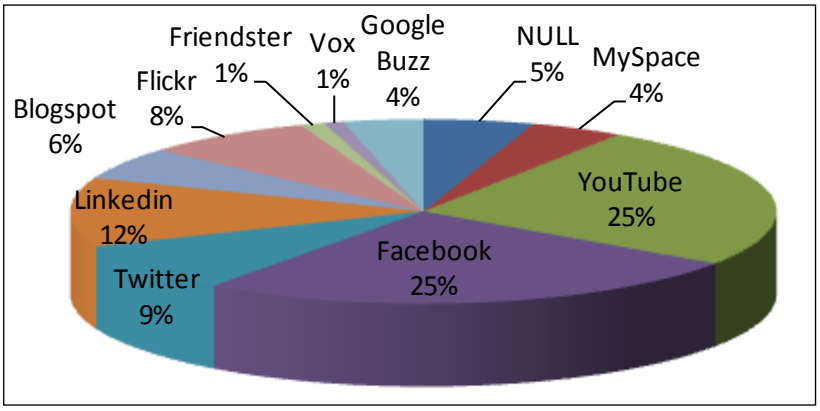


Figure 16: Use of social networks

Question 7: Frequency of use of social networks

Scope and rationale of the question

The aim of this question is to identify the frequency of use of social networking applications by the respondents of the questionnaire. The question used was the following:

- *Question: How often do you use a social networking application? (all the above options were available)*

The available options among which the respondents could choose in order to characterise how frequently they use a social networking application, were five, following the Likert scheme:

- Very often
- Often
- Sometimes
- Rarely
- Never

Analysis of results and conclusions

This question has been answered by about 90% of the participants of the survey. From the results we can see that more than half of the participants that have answered the questionnaire make frequent use of social networking applications (a percentage of more than 57% answered that they use social networking often or very often). About one out of four (24%) declared that they sometimes use a social application, while a percentage of 19% rarely or never use such applications. The results in this question are in full compliance to the answers given as regards the familiarity with social networking, as the percentages are similar, verifying once again the good level of awareness of the participants as regards the basic technological framework of the project.

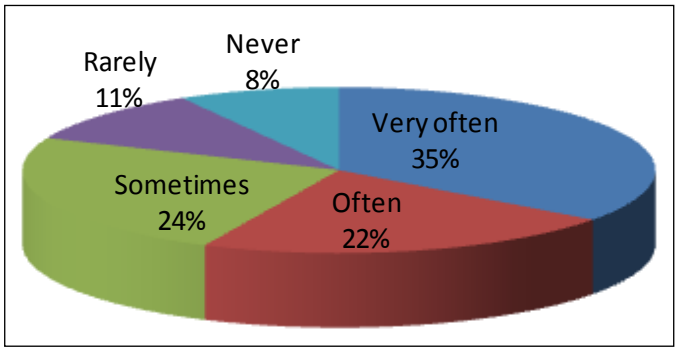


Figure 17: Frequency of use of social networks

Question 8: P2P application awareness

Scope and rationale of the question

The aim of this question is to identify whether the respondents are aware of P2P applications. The question used was the following:

- *Question Are you aware of P2P (Peer 2 Peer) applications?*

The available options to the users were:

- Yes
- No
- I do not know

Analysis of results and conclusions

This question was answered by 93% of the participants in the survey. From them, the majority (75%) have answered that they are aware of P2P applications while one out of five of them answered that they are not.A small percentage which reaches 5%, preferred to select the "I do not know:" option. . From the results of this question we can find out that a very high portion of those who answered the questionnaire (3 answers out of 4) are aware of P2P applications.

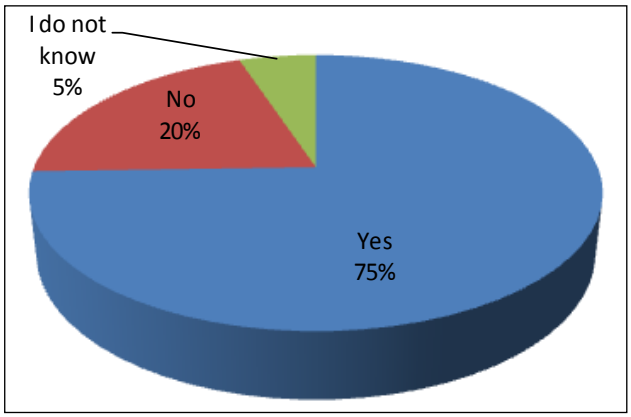


Figure 18: P2P application awareness

Question 9: Use of P2P clients

Scope and rationale of the question

This question aims to detect which of the already existing P2P clients are used from the respondents of the questionnaire. The question used was the following:

- *Question If yes, please indicate which of the following P2P clients you currently use (check all that apply)*

The available options to the users were:

- Bit Torrent
- Ares
- Kazaa
- Limewire
- eMule
- DC++
- Other (please state)

Analysis of results and conclusions

This question has been answered by 72% of the participants. From them, the answers collected indicate that there are three dominant P2P clients, as shown in Figure 19: Bit Torrent, Limewire and eMule, which together make up about 75% of the preferences of the participants in the survey, with Bit Torrent being the dominant client. These results indicate that users have embraced the reciprocal model of resource sharing used in Bit Torrent, and that use of similar models in the distribution of media streams could be easily adopted. The same applies to the technologies used for the distribution of the streams.

Users have embraced the reciprocal model of resource sharing used in Bit Torrent, and therefore use of similar models in the distribution of media streams could be easily adopted.

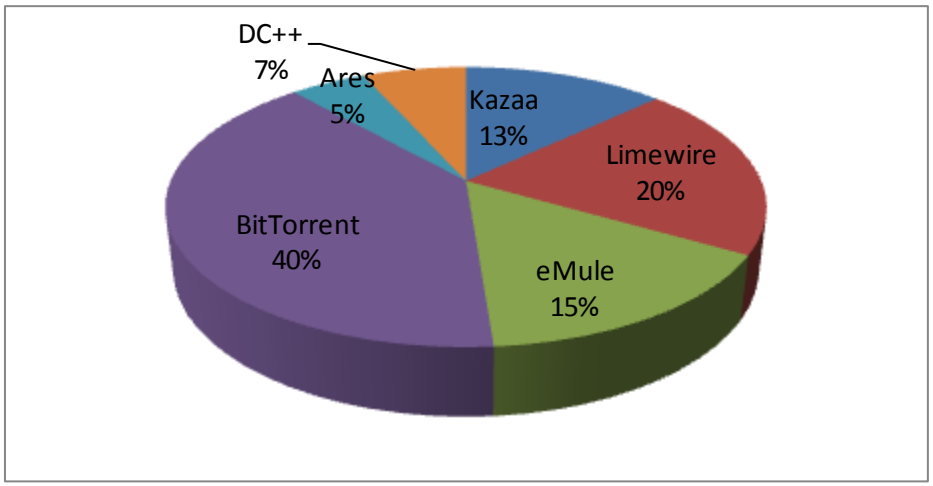


Figure 19: Use of P2P clients

Question 10a: Use of devices and equipment for internet access

Scope and rationale of the question

This question aims to detect what type of device respondents use daily and if they use the specific device for internet access. The question used was the following:

- *Question: Which of the following devices do you use for internet access? What type of equipment do you use on a daily basis? (check all that apply)*

The available options to the users were:

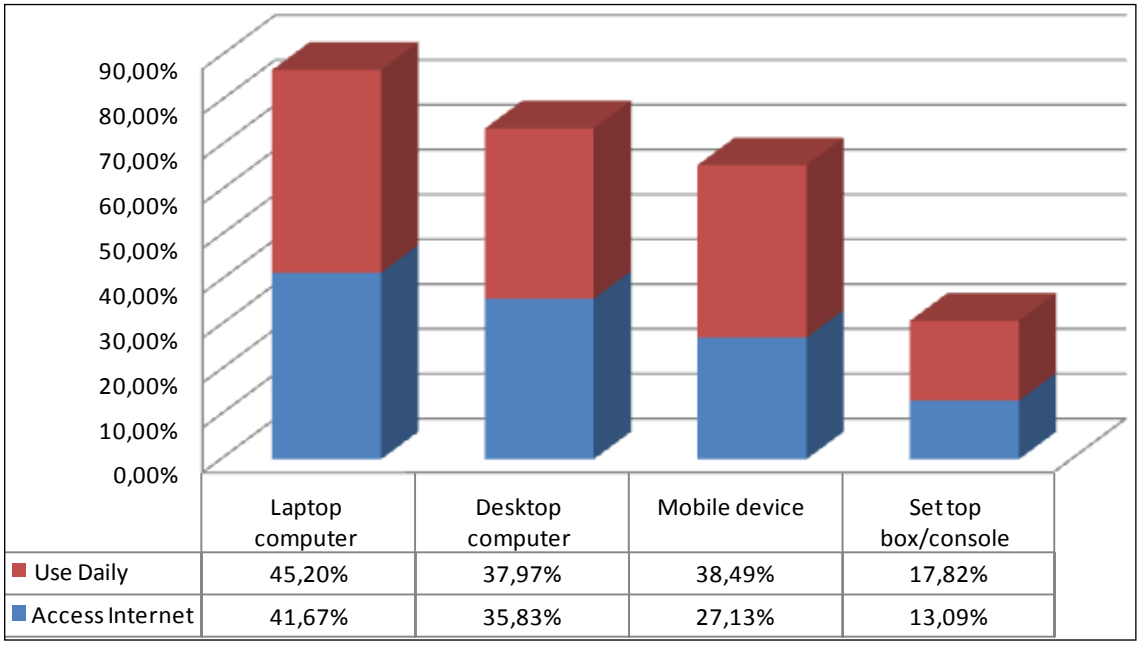
- Laptop computer
  - Access Internet
  - Use Daily
- Desktop computer
  - Access Internet
  - Use Daily
- Mobile device
  - Access Internet
  - Use Daily
- Set top box/ console
  - Access Internet
  - Use Daily

Analysis of results and conclusions

These four subsections of the question (Laptop computer, Desktop computer, Mobile device and Set top box/console) were answered by the following percentages of respondents: 86.87%, 73.80%, 65.62% and 30.91% correspondingly. We can easily observe that about half of the respondents use their laptop computer daily and for Internet access. In second place we can find desktop computer; approximately, a portion slightly higher than one out of three uses this type of device daily and for internet access. Mobile device category follows with the same percentage as desktop computer as regards daily access, but with 27% as far as

Laptop computer is the most popular device of the respondents as regards internet access, followed by the desktop computer and mobile device.

internet access is concerned. Finally, the smallest proportion appears in set top box console; its use do not exceed 20% in both daily use and internet access, so it seems to be the less often used for this purposes. We can come to the conclusion that the laptop computer is the most popular device of the respondents, followed by the desktop computer and mobile device. Set top box console is used substantially less.



	Laptop computer	Desktop computer	Mobile device	Set top box/console
Use Daily	45,20%	37,97%	38,49%	17,82%
Access Internet	41,67%	35,83%	27,13%	13,09%

Figure 20: Use of devices and equipment for internet access

Question 10b: Support of video streaming, mobile internet and VoIP in mobile devices

Scope and rationale of the question

The scope of this question is to detect the services supported by respondent's devices. We focus on three services: Video Streaming, Mobile Internet and VOIP. The question used was the following:

- *Question If yes, which of the following services does it support?(check all that apply)*
  - Video Streaming
  - Mobile Internet
  - VOIP

Analysis of results and conclusions

Six respondents out of ten answered to this question. As presented in Figure 21, half of the users' devices do support mobile internet. The other 50% is divided almost equally between the other two supported services: 29% support video streaming, while 21% support VOIP. We can conclude that users prefer devices with mobile internet support rather than the other services given as alternative choices in this specific question.

Users prefer devices with mobile internet support.

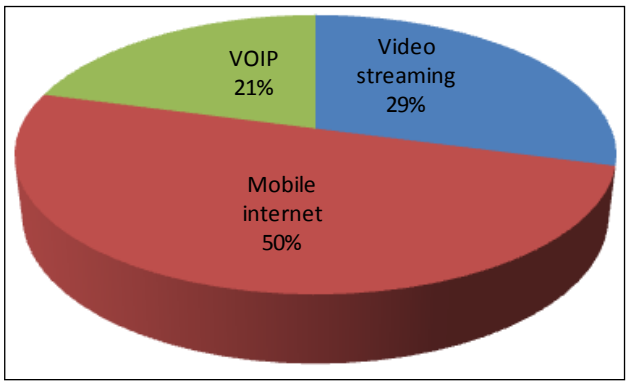


Figure 21: Support of video streaming, mobile internet and VoIP in mobile devices

Question10c: Internet and VoD support in SetTop boxes

Scope and rationale of the question

Here we aim to find out what kinds of services are supported by the set top box consoles used by the respondents. The question used was the following:

- *Question: If yes, which of the following services does it support?*

The possible choices the users could select were the following:

- VOD
- Internet services

Analysis of results and conclusions

This question was answered by almost the half of the respondents. The majority of the answers (78%) indicated that internet services were the most common characteristic of the set top boxes owned by the users, while only 22% of them support VOD service. This result, combined with the increasing accessibility of Set Top devices to the internet and internet services (i.e. TVs with internet capabilities, TV and mobile Widgets) advocate that use of the web as the platform over which media streaming should be provided in SARACEN is more promising than a closed environment similar to that of VoD services.

Use of the web as the platform over which media streaming should be provided in SARACEN is more promising than a closed environment similar to that of VoD services.

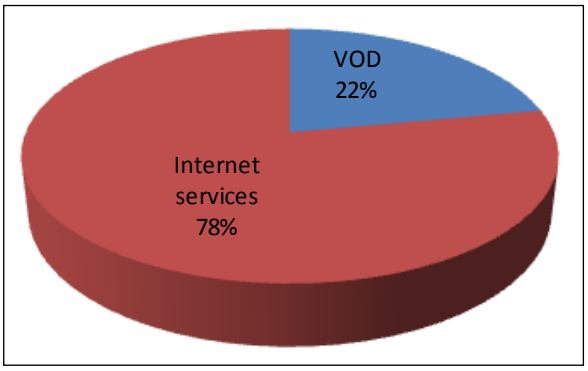


Figure 22: Internet and VoD support in SetTop boxes

Question 11: Type of internet connection at home

Scope and rationale of the question

This question aims to reveal what type of internet connection the respondents use in order to access internet in their homes. The question used was the following:

- *Question: What type of internet connection do you use home?*

The available options among which the users were asked to select the correct one in order to answer to the question were the following:

- Non high speed (Dial-up, ISDN)
- Wired Broadband <= 4Mbps
- Wired Broadband > 4Mbps
- Wireless Broadband <= 1Mbps
- Wireless Broadband > 1Mbps
- 3G services

Analysis of results and conclusions

All of the respondents answered this question. It is remarkable than none of them chose the non high speed (Dial-up, ISDN) connection as their internet connection at home. The highest percentage belongs to the wired broadband connection with speed less than 4Mbps (38%). The wireless broadband connection with speed larger that 1Mbps as well as the wired broadband connection with speed larger that 1Mbps were the second more prevalent choices. The percentage of each one of the choices reaches 25% on average. The less popular internet connection is 3G, with the percentage of 2%. The high speed access of the participants and the expected increase in the available bitrate (both for upload and download) indicate that streaming services supporting HD should be among the priorities of the project, while mobile devices should be used mostly as «end sink» terminals.

Streaming services supporting HD should be among the priorities of the project, while mobile devices should be used mostly as «end sink» terminals.

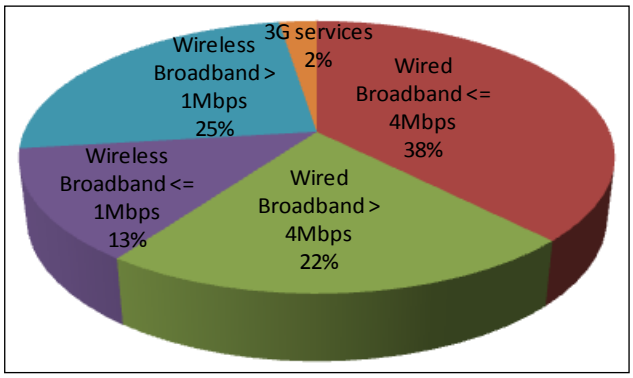


Figure 23: Type of internet connection at home

Question 12: Type of wireless network technologies used for online content access

Scope and rationale of the question

The scope of this question is to specify the type of wireless network technologies used by the respondents for online content access. The question used was the following:

- *Question: What type of wireless network technologies do you use to access online content? (check all that apply)*

The users were asked to choose among the following options of wireless network technologies:

- GSM

- 3G
- WiFi
- DVB

Analysis of results and conclusions

The question was answered by 84% of the respondents. Wi-Fi is the most prevalent wireless network technology, accounting for almost 60% of all answers. 3G wireless technology follows with a considerably smaller percentage of 27% of all answers. Fewer still selected GSM technology, which gathered a slightly higher percentage than one out of ten. Finally, the option with the lowest percentage of answers (3%) was the DVB technology. The results of this question come to further support the conclusions of the previous question as regards the use of network technologies and video format.

WiFi support should be given top priority as regards support for wireless and mobile technologies in the project.

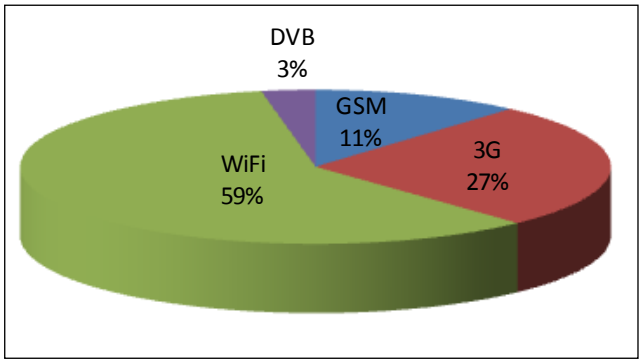


Figure 24: Type of wireless network technologies used for online content access

5.3.3 GROUP C: Viewing habits

Question 13: Importance of real time support for accessing different content types

Scope and rationale of the question

This question refers to the type of content the respondents would prefer to watch live. The question used was the following:

- *Question: Which of the following content would you like to watch live? (check all that apply)*

The possible options follow:

- Athletic events / sports
- Concerts
- News
- TV shows

Analysis of results and conclusions

Observation of the results shows that there are no significant differences between the percentages which show the preference of the users as regards the different types of content. Athletic events/sports and News categories was chosen by just under one out of three respondents. TV shows was chosen by one out of four users, while one out of five users prefer to see concerts live. From the results of this question, it is obvious that no strong preference as regards the specialization of the platform is detected. Therefore, the SARACEN platform should be able to support all possible types of live content coverage.

SARACEN platform should be able to support all possible types of live content coverage.

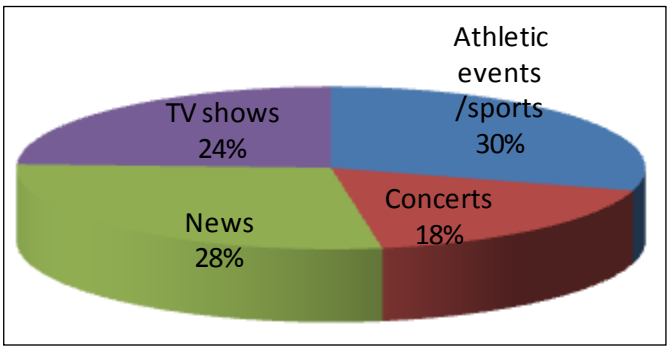


Figure 25: Importance of real time support for accessing different content types

Question 14: Preference for use of services

Scope and rationale of the question

This question aims to detect the interest of the respondents as regards specific services

There, different sub-questions corresponding to the above were used for this.

Question Please indicate which of the following services you are likely to use:

- *Question a: Share my own generated content, such as videos and photos, through my social networks*
- *Question b: Share my personal videos (over P2P networks)*
- *Question c Share my videos from all my Social networks through one application*
- *Question d: View videos which are shared by my friends*
- *Question e: Watch a live concert or a football match over P2P live streaming*
- *Question f: Create groups with other users having the same interests as you regarding videos, photos etc.*
- *Question g: Get informed if a user in your group uploads a new video*
- *Question h: Watch VOD in HD format*

The users were able to select among the following answers for indicating their likeness in the previous questions:

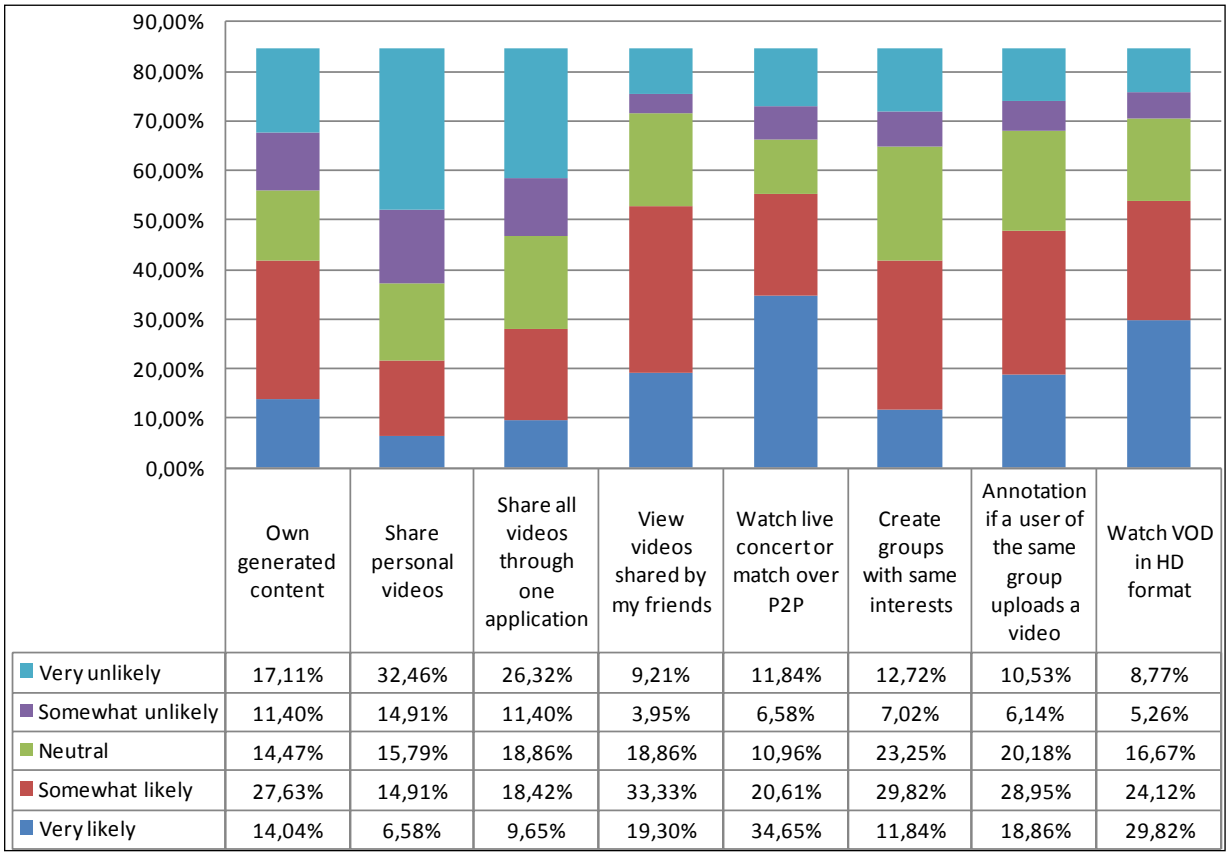
- Very likely
- Somewhat likely
- Neutral
- Somewhat unlikely
- Very unlikely

Analysis of results and conclusions

The greater percentage of those who answered the first question (28%), are somewhat likely to share their own generated content through social networks. The respondents seem to be much more wary in sharing their videos in P2P applications, since one out of three of them are very unlikely to do so. Sharing all videos through one application seems to have disunited the respondents; 27% of them are likely to do so, while 37% of them are unlikely. One out of three respondents is somewhat likely to view videos which are shared by his/her friends, while just 19% are very likely to view such videos. Watching live concerts or matches over P2P seems to be as popular choice; about 55% of the respondents are very likely or somewhat likely to watch music and sports over P2P whilst 40% are very likely or somewhat likely to create groups with same interests. Almost half of the users are also somewhat likely or

very likely to want to be informed if a user in their group uploads a new video. Finally, one out of three users is very likely to watch VOD in HD format.

To summarise the above findings we can say that there seems to be interest in the transmission of live content of sports or concerts over P2P architectures (with the participation of users in the media distribution network), while the majority prefers participation through groups of the same interest as regards content. Finally, most of the respondents would be interested in providing annotations to streaming video. The majority support the core idea of SARACEN for media distribution over P2P networks based on the processing of user profiles in order to increase efficiency and robustness of the P2P architecture.



	Own generated content	Share personal videos	Share all videos through one application	View videos shared by my friends	Watch live concert or match over P2P	Create groups with same interests	Annotation if a user of the same group uploads a video	Watch VOD in HD format
Very unlikely	17,11%	32,46%	26,32%	9,21%	11,84%	12,72%	10,53%	8,77%
Somewhat unlikely	11,40%	14,91%	11,40%	3,95%	6,58%	7,02%	6,14%	5,26%
Neutral	14,47%	15,79%	18,86%	18,86%	10,96%	23,25%	20,18%	16,67%
Somewhat likely	27,63%	14,91%	18,42%	33,33%	20,61%	29,82%	28,95%	24,12%
Very likely	14,04%	6,58%	9,65%	19,30%	34,65%	11,84%	18,86%	29,82%

Figure 26: Preference for use of services

5.3.4 GROUP D: Media/quality/price

Question 15: Willingness to access content containing marketing material

Scope and rationale of the question

The scope of this question is to examine the willingness of the respondents to accept advertising content as an alternative to payment for the use of personalised streaming services. The question used was the following:

- *Question: Would you be willing to use a service that allows you to have personalised content (e.g. video recommendations, share your own generated HD content) for free if it contained marketing material e.g. video advertisements?*

The users were able to select among the following answers to express their willingness to the content of the question:

  - Yes

- No

Analysis of results and conclusions

This question was answered by 80% of the respondents. The highest percentage of the answers were positive (69%), while the rest (31%) were negative as regards the use of a service that allows users to have personalised content for free if it contained advertising material. This question is related to the possible business models for commercial implementation of the project results. It seems that the use of advertising as a means of avoiding or reducing customers cost for using the platform would be acceptable by the majority of users.

> Use of advertising as a means of avoiding or reducing customers cost for using the platform would be acceptable by the majority of users

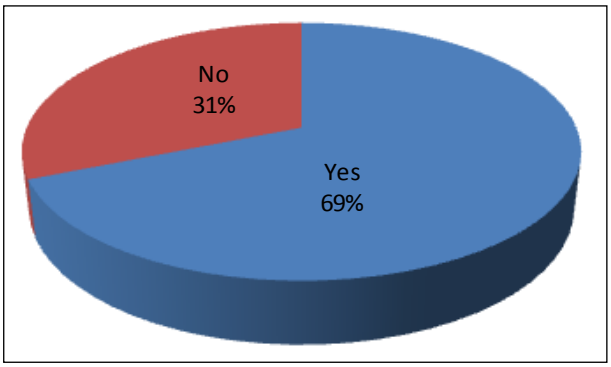


Figure 27: Willingness to access content containing marketing material

Question 16a: Willingness to view advertisements to reduce cost of service

Scope and rationale of the question

The scope of this mandatory question is to detect whether the respondents are willing to view advertising material in order to cover all or part of the cost of the corresponding video streaming service. The question used was the following:

- *Question: Would you be willing to view advertising material in order to cover all or part of the cost of this service?*

The respondents had the following options:

- Yes
- No

Analysis of results and conclusions

The question was answered by four out of five of the respondents. On average, two thirds of them are willing to view advertising material in order to cover all or part of the cost of the service, while the rest do not agree with the statement. The results here are similar to the previous question. It should be noted that the questions are similar. However, the previous refers to the content and links the advertisements to the personalised content while the second refers to advertisements in general. In both cases users seem willing to accept advertisements in order to reduce the cost for accessing personalised streaming services.

> Users seem willing to accept advertisements in order to reduce the cost for accessing personalised streaming services.

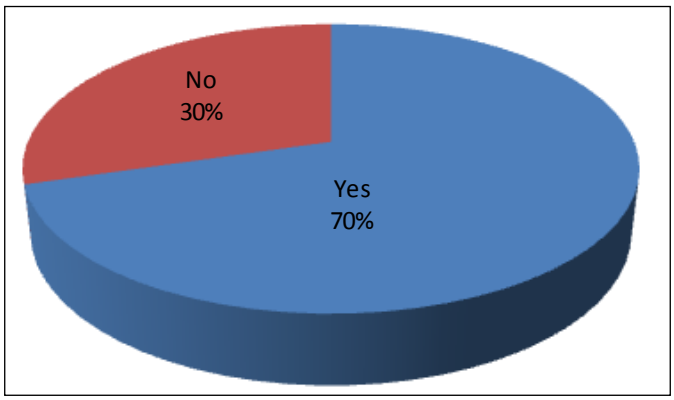


Figure 28: Willingness to view advertisements to reduce cost of service

Question 16b: Preference in viewing advertisements

Scope and rationale of the question

This question was optional and was addressed to those who have answered positively to the previous question. It aims to specify the temporal moment where the users prefer to view the advertisement. The question used was the following:

- *Question If YES, when would you prefer to view the advertisement?*

The possible answers given as choices to the respondents follow:

- N/A
- before the content to be visualised
- superimposed on the content as it is being visualised
- both

Analysis of results and conclusions

The question was answered by the half of the respondents. There were only two selected choices from the four given: 81% of the users declared they prefer viewing the advertisement before the content, while the rest 19% of them felt it better to watch the advertisement superimposed over the content whilst watching it. The conclusion is that the users would prefer a non-interrupted viewing experience, similar to that of coverage of a football match.

Users would prefer a non-interrupted viewing experience, similar to that of coverage of a football match.

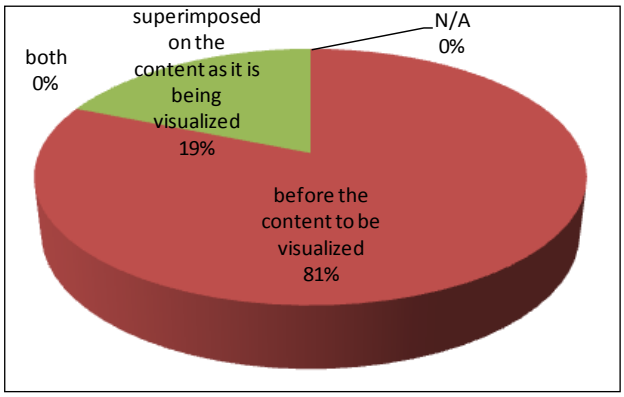


Figure 29: Preference in viewing advertisements

Question 17: Frequency of VOD services use

Scope and rationale of the question

This question is mandatory and refers to how often the respondents make use of Video On Demand (VOD) services. The question used was the following:

- *Question: How often do you use Video on Demand services?*

The available options among which the respondents could choose in order to characterise how frequently they use Video on Demand, were five, following the Likert scheme:

  - Very often
  - Often
  - Sometimes
  - Rarely
  - Never

Analysis of results and conclusions

This question was answered by 80% of the respondents to the questionnaire. One out of three respondents declared that they use VoD services often or very often (17% and 13% correspondingly), while one out of four answered they sometimes use such services and 28% of them that they rarely do so. Finally, negative answers (never option) increased to 17% of the whole. The results indicate that the majority of users do not make frequent use of VoD services. One reason for the results here could be the type of content access in the internet, which consists mainly of short videos (which cannot be considered VoD) and live streams. Based on this, and according to the DoW of the project, the platform should emphasise real time streaming, with the ability of incorporating small videos with no need for enhanced PVR functionality.

The platform should emphasise real time streaming, with the ability of incorporating small videos with no need for enhanced PVR functionality.

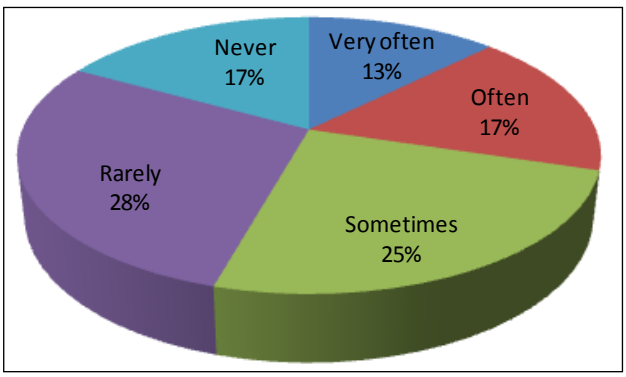


Figure 30: Frequency of VOD services use

Question 18: Willingness to pay for different types of streaming services

Scope and rationale of the question

The aim of this mandatory question is to detect the willingness of the users as regards payment for the services provided. The sub-questions used were the following:

- *Question18a: I am willing to pay for an added value service that allows me to contribute my own content (text, pictures) during a transmission.*
- *Question18b: I am willing to pay for an added value service that allows me to contribute my own content (text, pictures) during a transmission.*
- *Question18c: I am willing to contribute in alternative ways instead of money: (e.g. offer the use*

of my own equipment as part of the distribution chain even when I'm not viewing)

- *Question18d: I am willing to pay an extra amount of money for viewing HD Videos on Demand*

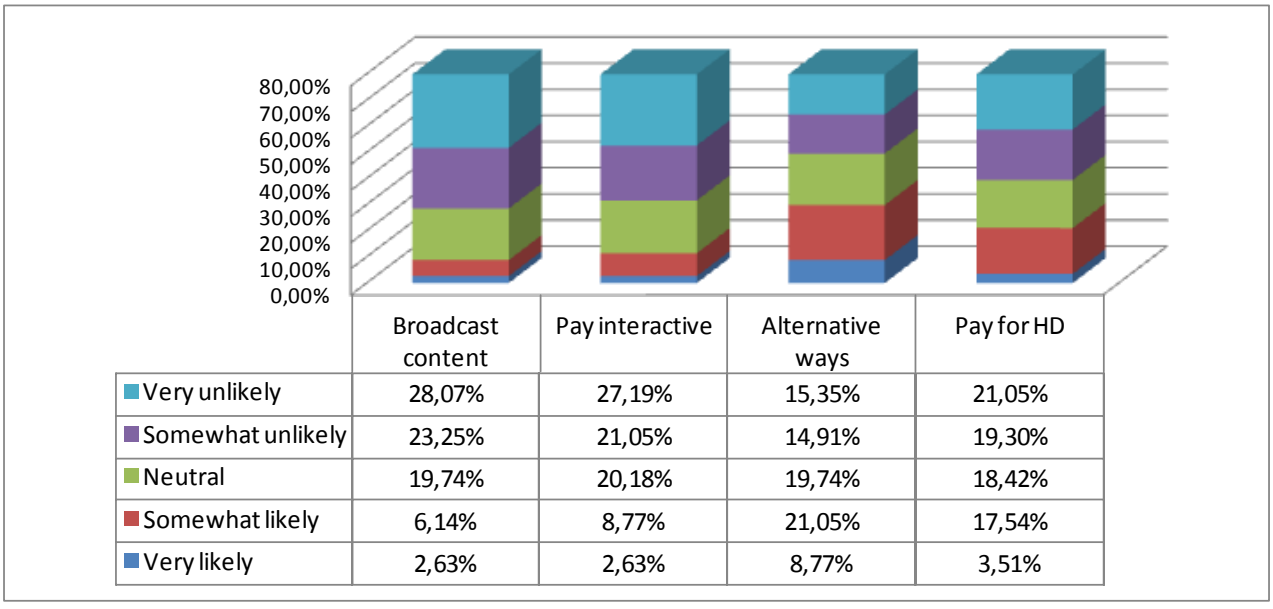
The users were able to select among the following answers for indicating their willingness in the previous questions:

- Very likely
- Somewhat likely
- Neutral
- Somewhat unlikely
- Very unlikely

Analysis of results and conclusions

Answers gathered in this question came from 80% of the sample. According to the results, the respondents seem not very willing to pay for various services provided by the platform, except for the HD VoD, where 20% percent of the users are somewhat or very likely to pay for such a service. In addition, they seem to support the idea of contributing in alternative ways instead of money. From the above we can conclude that as regards the business models, revenue through subscriptions and payment of users should focus on the distribution of HD content, while alternative means (participation in the P2P distribution scheme through their nodes, accepting advertisement messages) should be considered.

> Revenue through subscriptions and payment of users should focus on the distribution of HD content, while alternative means (participation in the P2P distribution scheme through their nodes, accepting advertisement messages) should be considered.



	Broadcast content	Pay interactive	Alternative ways	Pay for HD
Very unlikely	28,07%	27,19%	15,35%	21,05%
Somewhat unlikely	23,25%	21,05%	14,91%	19,30%
Neutral	19,74%	20,18%	19,74%	18,42%
Somewhat likely	6,14%	8,77%	21,05%	17,54%
Very likely	2,63%	2,63%	8,77%	3,51%

Figure 31: Willingness to pay for different types of streaming services

5.3.5 GROUP E: Personalisation & Privacy

Question 19: Use of personal information and content in the platform

Scope and rationale of the question

The scope of this mandatory question is to detect users' opinion as regards privacy issues, protection of private information, installation of new applications. The sub-questions used were the following:

- *Question 19a: I am willing to provide personal preferences information to my service provider in*

order to improve your viewing experience through personalization.

- *Question 19b: I am willing to provide my profile information for the formation of user groups in order to improve personalization*
- *Question 19c: I am willing to install a new application on my personal device in order to have access to a P2P media streaming service.*
- *Question 19d: I am aware of the personal data protection framework*
- *Question 19e: Willingness to share content with other users.*
- *Question 19f: Willingness to enable other users to download content that belongs to me*
- *Question 19g: Willingness to download content, despite of the possibility of downloading malicious software (viruses, Trojan horses etc)*

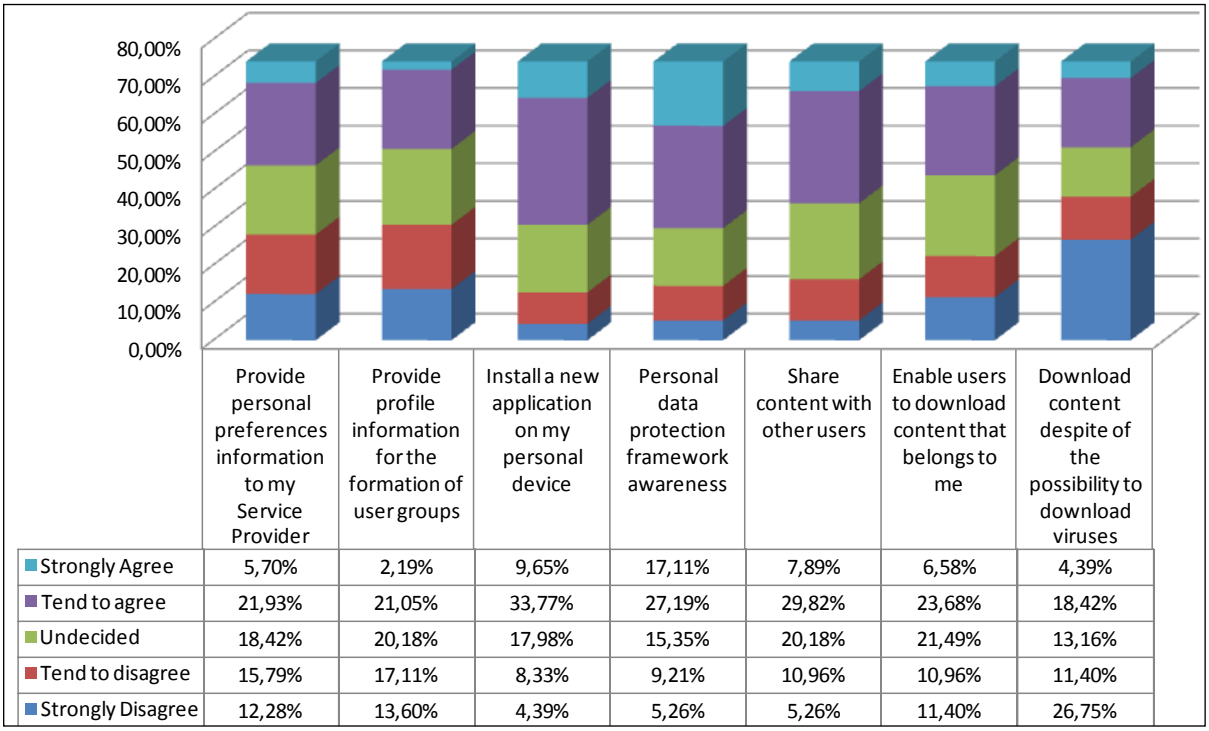
The choices the users had to select in order to answer to the above questions were the following five:

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Analysis of results and conclusions

These questions were answered by 75% of respondents. With the exception of the last question, the percentage of respondents who tend to agree with the statements given, are higher when compared to those who agreed with the other choices (undecided, tend to disagree, etc). In the last question, users tend to be more wary as regards downloading content despite the possibility to download malicious software. Users in general seem willing to provide personal preference information and sharing content in order to participate and support the provision of a personalised media distribution service. This could be attributed to the wide use of P2P and social networking applications. The project should take advantage of this fact which is in accordance with the initial planning for the architectural scheme of the project's platform. Special care should be taken in order to ensure protection against viruses and malicious software downloads.

> Users in general seem open to providing personal preference information and sharing content in order to participate and support the provision of a personalised media distribution service. Special care should be provided in order to ensure protection against viruses and malicious software downloads.



	Provide personal preferences information to my Service Provider	Provide profile information for the formation of user groups	Install a new application on my personal device	Personal data protection framework awareness	Share content with other users	Enable users to download content that belongs to me	Download content despite of the possibility to download viruses
Strongly Agree	5,70%	2,19%	9,65%	17,11%	7,89%	6,58%	4,39%
Tend to agree	21,93%	21,05%	33,77%	27,19%	29,82%	23,68%	18,42%
Undecided	18,42%	20,18%	17,98%	15,35%	20,18%	21,49%	13,16%
Tend to disagree	15,79%	17,11%	8,33%	9,21%	10,96%	10,96%	11,40%
Strongly Disagree	12,28%	13,60%	4,39%	5,26%	5,26%	11,40%	26,75%

Figure 32: Use of personal information and content in the platform

Question 20: Use of advanced searching functionality

Scope and rationale of the question

The scope of this mandatory question is to examine the level of interest of users as regards the elaboration of various searches. The sub-questions used were the following:

- *Question 20a: How interested would you be in sharing your saved searches and content filters with your friends and family and the general public?*
- *Question 20b: How interested would you be in seeing and collecting the saved searches and content filters that have been made by other people who share your interests?*
- *Question 20c: How interested would you be in setting up persistent searches, and receiving spontaneous alerts that there was something interesting to see?*

The level of interest of the users could be characterised by the following five statements:

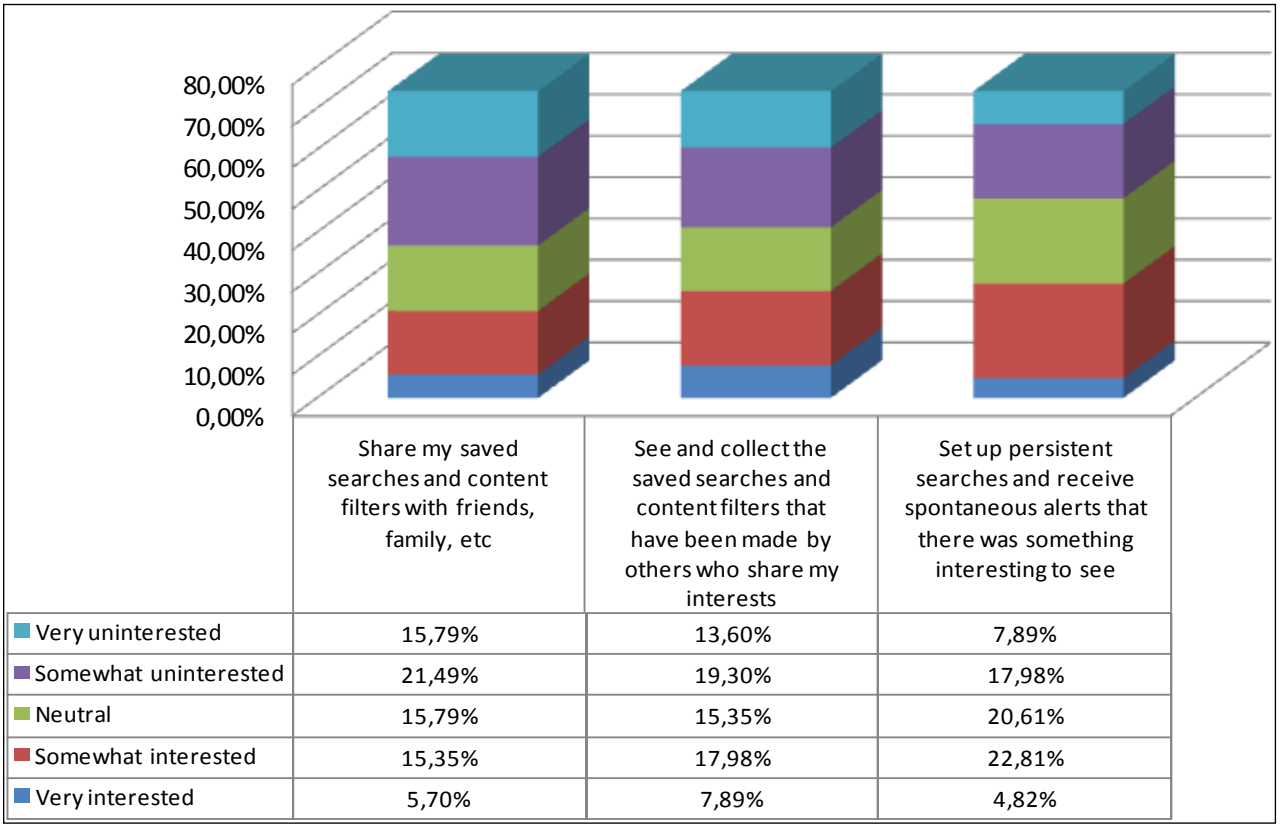
- Very interested
- Somewhat interested
- Neutral
- Somewhat uninterested
- Very uninterested

Analysis of results and conclusions

Three respondents out of four answered the above questions. About 25% of the respondents declared that they are very or somewhat interested in the three statements. The percentage of those who are neutral or somewhat uninterested is on average 36% in all three statements. The rest of the answers were negative, which means users were very uninterested in the subject of the question. From this we conclude that there is an interest in added value search mechanisms that take into account the behavior of users in or-

SARACEN platform should consider the provision of advanced searching mechanisms. However, these should not be given top priority.

der to facilitate future searches, but this feature does not seem to be considered very important. Therefore, though the platform should consider the provision of such mechanisms, these should not be given top priority.



	Share my saved searches and content filters with friends, family, etc	See and collect the saved searches and content filters that have been made by others who share my interests	Set up persistent searches and receive spontaneous alerts that there was something interesting to see
Very uninterested	15,79%	13,60%	7,89%
Somewhat uninterested	21,49%	19,30%	17,98%
Neutral	15,79%	15,35%	20,61%
Somewhat interested	15,35%	17,98%	22,81%
Very interested	5,70%	7,89%	4,82%

Figure 33: Use of advanced searching functionality

Question 21: Use and willingness to pay for scalable video functionality

Scope and rationale of the question

This mandatory question refers to a video regarding Scalable Video Coding, prepared from the partners of the project to show in practice, the way SVC works on a video with viewing problems. The sub-questions used were the following:

- *Question 21a: I could clearly see the difference in quality of the 2 streams in the video*
- *Question 21b: The video helped me to understand the benefits of Scalable Video Technology*
- *Question 21c: I would pay for a technology that enables me to watch recorded videos in any format (SD or HD)*

After watching the video, the users had to answer to the above three questions, using the following five possible statements:

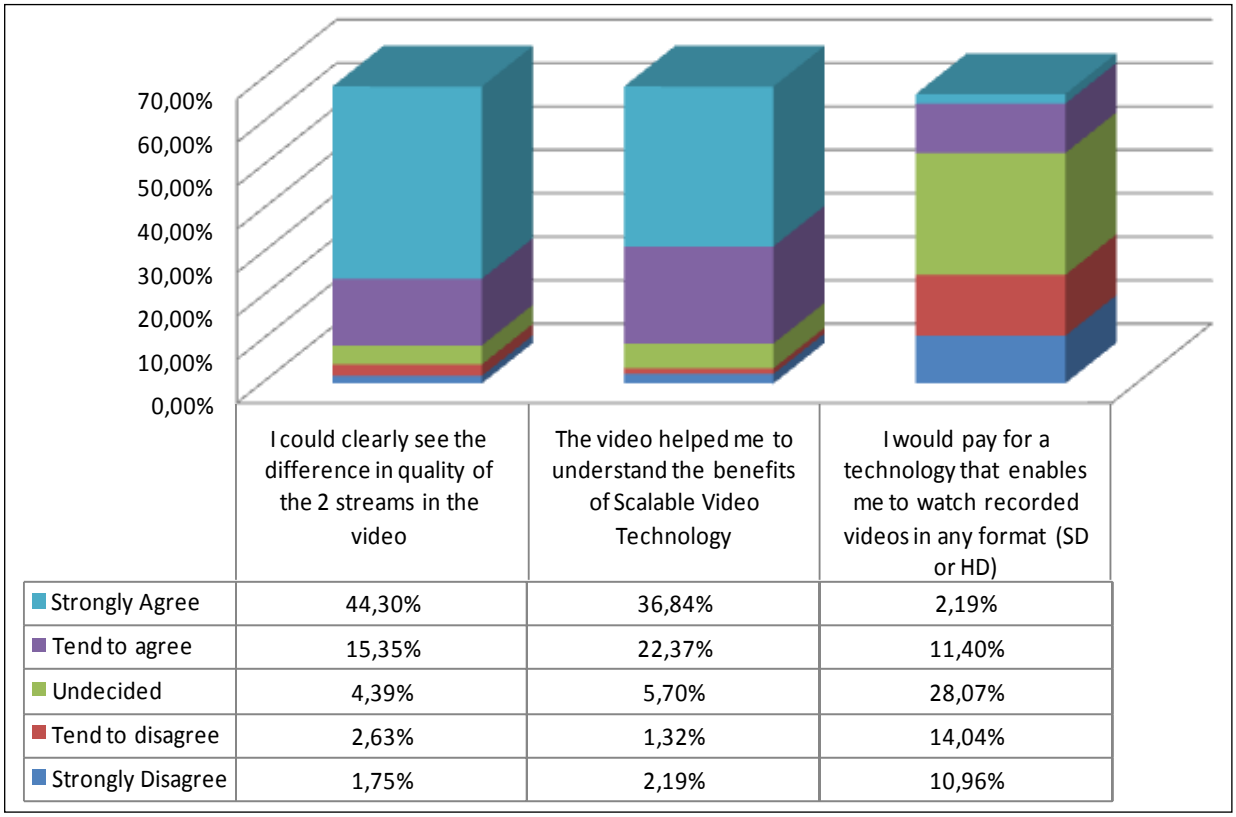
- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Analysis of results and conclusions

The vast majority of respondents (44,3%) could easily

The project should carefully select use cases that can clearly demo**nstrate the benefits of scalable coding and the enhanced adaptability functionality they provide for the platform.**

discriminate the difference before and after the use of SVC in the video. Almost 60% of them strongly or tend to agree that the video helped them to understand the benefits of SVC technology. As regards the issue of payment, only a small percentage (around 13,5%) would be willing to pay for a technology that enables watching of recorded videos in any format (SD or HD). From this we can conclude that although users are able to identify the benefits of the scalable coding technologies, they are not yet ready to make payment for the ability of having this adaptive viewing that allows them to access content in different qualities ranging from HD to SD. This can be explained by the fact that the scalable coding has not yet been deployed in the market, with the corresponding use cases available to help the users identify practical benefits. Therefore, the project should carefully select use cases that can clearly demonstrate the benefits of scalable coding and the enhanced adaptability functionality they provide for the platform.



	I could clearly see the difference in quality of the 2 streams in the video	The video helped me to understand the benefits of Scalable Video Technology	I would pay for a technology that enables me to watch recorded videos in any format (SD or HD)
Strongly Agree	44,30%	36,84%	2,19%
Tend to agree	15,35%	22,37%	11,40%
Undecided	4,39%	5,70%	28,07%
Tend to disagree	2,63%	1,32%	14,04%
Strongly Disagree	1,75%	2,19%	10,96%

Figure 34: Use and willingness to pay for scalable video functionality

Question 22: Use and willingness to pay for video tagging

Scope and rationale of the question

This mandatory question refers to a video regarding media tagging, prepared from the partners of the project to show in practice, what exactly does media tagging mean and how helpful can it be for the users. The sub-questions used were the following:

- *Question 22a: The video helped me to understand the benefits of video media tagging*
- *Question 22b: Video media tagging would be of great benefit to me*
- *Question 22c: I would pay for a technology that enables me to tag recorded videos in any format (SD or HD)*

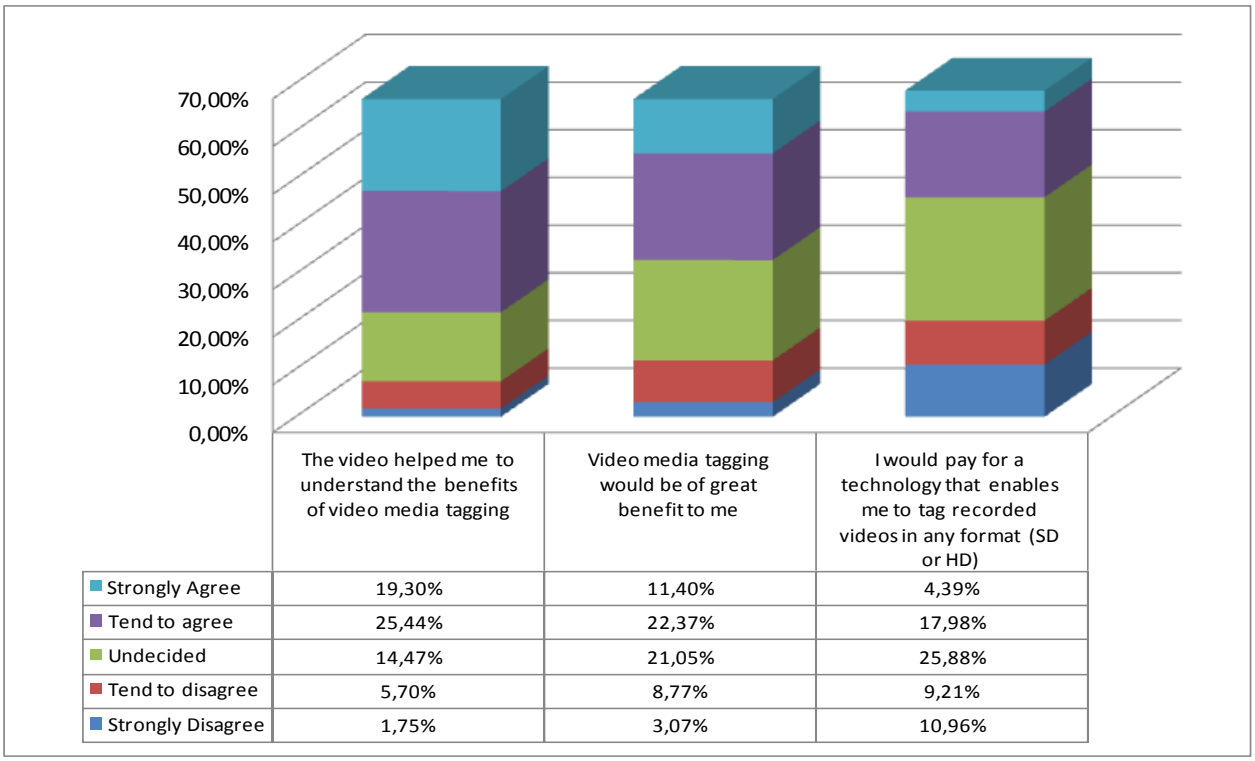
After watching the video, the users had to answer to the above three questions, using the following five possible statements:

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Analysis of results and conclusions

45% of respondents strongly agree or tend to agree that the video helped them to understand the benefits of video media tagging, while one out of three of the respondents strongly agree or tend to agree that video media tagging will be of great benefit to them. Nevertheless, users are not so willing to pay for a technology that will enable them to tag recorded videos in SD or HD format. The results are in line with the results of the previous question and indicate that users are interested in using video tagging, but would not consider paying for it (in fact users are more strongly opposed to paying for tagging than for accessing video in different formats). Therefore, tagging capabilities should be offered as added value functionality but for free. After all, the users, through tagging of the videos contribute to the enhancement of the content.

Tagging capabilities should be offered as added value functionality but for free.



	The video helped me to understand the benefits of video media tagging	Video media tagging would be of great benefit to me	I would pay for a technology that enables me to tag recorded videos in any format (SD or HD)
Strongly Agree	19,30%	11,40%	4,39%
Tend to agree	25,44%	22,37%	17,98%
Undecided	14,47%	21,05%	25,88%
Tend to disagree	5,70%	8,77%	9,21%
Strongly Disagree	1,75%	3,07%	10,96%

Figure 35: Use and willingness to pay for video tagging

5.4 Summary of conclusions

The conclusions presented in the analysis section of each question provide valuable input for the design of the platform architecture, the selection and use of technologies and the selection of business models and use cases. In order to transform the conclusions into valuable input to be used in the specifications work package of the project, these conclusions are presented as a list of requirements in section 7.

This list of requirements is also influenced by the rest of requirement capturing methodologies, and will be used as a reference point for future deliverables.

6 Experts' interviews

In order to complete the requirements capturing process, the project has also addressed questions related to the use of technologies to experts in multimedia and media distribution. This will enable us to successfully link the requirements expressed by end-users, through the completion of the corresponding questionnaire, with the Description of Work. In order to fully exploit the experts' knowledge of the use and deployment of technologies proposed by the project, interviews based on questionnaires were carried out, allowing the experts to freely express their opinions. The corresponding methodology is described in the following subsection.

6.1 Methodology

The experts' answers were captured by using questionnaires consisting of focused questions, which the experts were asked to complete, not simply with specific answers, but also by freely expressing their opinions. The questionnaires were completed either in writing, or following discussions/semi-structured interviews on the based on questionnaires. The experts' opinions were recorded following two main approaches:

The first approach was **project internal,** based on a separate questionnaire addressed to experts by the project partners. The questionnaire included 15 questions to try to record the opinions of specialists whose knowledge was focused on fields directly applicable to the technical background of the project. Since there are enough experts working within the SARACEN partner organizations, the questionnaire was decided to be addressed to these experts. The data collected from these responses will be used to optimise the decisions affecting project implementation.

The second direction was **project external**, and was decided to focus particularly on the issue of codecs' use. In this context, the consortium approached W3C[1] to complete a questionnaire of 12 questions related to the use of HTML5 - considered the emerging web standard on media streaming.

The results of both approaches are reported in this section. It should be noted that the analysis and conclusions taken from the experts' answers are provided as a summary compiled after all answers were processed.

6.2 Tools Used

The questionnaire was designed as a semi-structured interview distributed to our experts mainly in electronic form via email. However, some questionnaires were given in printed form, and completion of these followed a brief discussion with the experts. Every project partner (for the internal survey) completed the questionnaire with the experts in their team, and completed a table containing information about each expert. Specifically, the experts who answered the questionnaire filled in the table with information such as the company or the institution they represent, the position they hold there, their area of expertise, and their familiarity with the SARACEN project research topics, using a scale from 1 to 5.
As regards the external survey on HTML5, the corresponding experts' questionnaire was compiled following several iteration rounds in which every partner contributed not only questions but also possible answers and concerns. The questionnaire was then sent to W3C experts, who have reported back, completing the document.

6.3 Demographics of the internal questionnaire

As detailed above, a table containing the basic information of experts who answered the internal questionnaire in this survey was compiled. This table follows.

[1] The SARACEN consortium would like to thank Mr Philip Hoschka, the Deputy Director of the *W3C,* for his help and support in the project, in completing the external experts' questionnaire on HTML5 issues.

Expert no	Company/institution (maybe an expert outside the institution)	Areas of expertise	Position held	Familiarity with SARACEN research topics (1-5) (1=lowest, 5=highest)
1	KOC	Multimedia networking	Professor	5
2	ICCS	Networking	Senior researcher	5
3	ICCS	Networking	Senior researcher	5
4	ICCS	Software engineer	Junior researcher	4
5	ICCS	Multimedia networking	Senior researcher	4
6	Primetel	Networking	CTO	5
7	Primetel	Software engineer	Research Analyst	5
8	QMUL	Multimedia Content Analysis	Professor	5
9	QMUL	Multimedia networking	Senior Researcher	5
10	QMUL	Networking	Junior Researcher	3
11	INOV	Networking	Professor	5
12	INOV	Networking	Assistant Professor	5
13	INOV	Multimedia networking	Adjunct Professor	5
14	CTVC	Multimedia networking	IT Manager at TV Production Company	2
15	CTVC	Digital Tech Development	Professor	5
16	CTVC	Future internet architecture	Senior Researcher	4
17	CTVC	Web development, multimedia, networking	Programmer	3
18	NTV	Multimedia Content Analysis	CTO	4
19	NTV	Multimedia networking	IT manager	4

20	ATOS	Multimedia networking	Research Engineer	5
21	Kendra	Networking, Multimedia, Semantic Web	System Architect	5
22	Kendra	Web development, Multimedia	System Architect	3
23	Kendra	Web development, Multimedia	Front-End Architect	3
24	Kendra	Future internet architecture	Entrepreneur	2
25	AGH	Telecommunications	Professor	4
26	AGH	Telecommunications	PhD Student	4
27	AGH	Telecommunications	MSc Student	2

Table 2: List of experts

From the above table, we can see that the majority of the experts have as area of expertise Multimedia networking. In detail, at least 12 of the experts (50%) have multimedia as area of expertise, while 17 (about 70%) had networking as area of expertise. Based on the research area of the project (Objective ICT-2009.1.5, Networked Media and 3D Internet) and the goals and objectives of SARACEN, the above numbers indicate that the selection of experts is appropriate to provide valuable answers as regards requirements. Furthermore, areas covering application development and web applications are also covered, with 7 experts declaring expertise in these areas[2].

6.4 Presentation and analysis of internal experts questionnaire

6.4.1 Question 1: Use of P2P application as a plug in

Scope and Rational of the question

The aim of this question is to determine whether experts support the integration of the SARACEN platform inside a browser, in order to minimise user involvement such as installation and configuration.

Analysis of results and Conclusions

In this question the two thirds of the answers were positive regarding the development of a SARACEN browser plug-in.

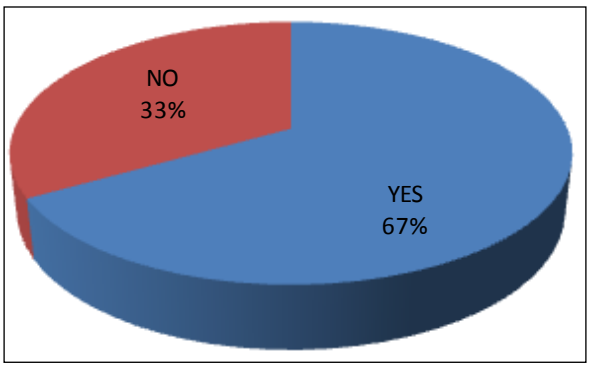


Figure 36: Use of P2P application as a plug in

[2] It should be noted that some experts have indicated expertise in more than one areas (i.e. multimedia and networking)

The positive answers from the experts, is based on the fact that a plug-in will be much easier for the end-user for many reasons. First of all, it provides a user-friendly approach, as the end-user doesn't have to install anything to make it work. A plug-in is the simplest way of building a rich user interface for video and decouples the development of the video and P2P software from the user interface. When the user enters the web site there is only a prompt for an automatic installation with almost zero configurations. Attention should be given to the browser compatibility, because browsers' features change. Another important point that experts highlighted is that the browser plug-in is quite handy for handheld devices. Secondly the plug-in browser solution makes it easier for 3rd party projects to integrate, via standardised NPAPI browser API which is supported by the majority of browsers - Internet Explorer being a notable exception. Finally a strong argument regarding the use of plug-ins is the transparent use across all operating systems and browser configurations. Furthermore, browser support for JavaScript provides a rich toolkit for development of cross-domain dynamic web services.

The majority of experts seem to be in favour of using a browser plug-in for P2P application module. However, as even in this case, installation will be required, the adoption of a download and install application is not excluded.

On the other hand, one third of the answers express that there is no need of use of browser plug-in, as it has almost the same capabilities as a download-and-install application, meaning that users will consider before downloading either of them. Also they point out that there is no difference between releasing a NPAPI/ActiveX plug-in or an install application, as in both cases the user will need to approve and install software into his/her computer. Moreover, most NPAPI/ActiveX plug-ins are usually released with a full desktop application (like Real Player, QuickTime or Acrobat). However, there are some examples of successful services that force the user to install an application, as Skype, Google Earth, iTunes or Spotify.

A middle ground that seems to appeal to both sides is the release of a Flash or Silverlight application. The problem that has to be solved here is that their security sandboxes will prevent the project from using P2P communication platforms. This is the reason why, at this moment, all P2P services are desktop applications. However, new technologies should be explored, like .NET Applets and Google Native Client.

6.4.2 Question 2: Use of HTML5 in SARACEN

Scope and Rationale of the question

This question attempts to determine the opinion of experts regarding the level of development of HTML5 and whether it is worth using in the SARACEN platform.

Analysis of results and Conclusions

In this question two out of three experts have answered that the HTML5 is a well-tested language and mature enough to be used in SARACEN's platform. The rest feel that HTML5 is not a well enough tested language in order to be used in the project.

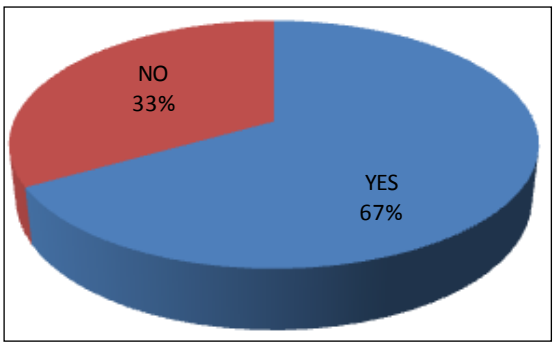


Figure 37: Use of HTML5 in SARACEN

More analytically, experts who agree with the use of HTML5 argue that it can be used (and is currently already adopted by major players in the market) for web-based content. More specifically, it provides

multimedia streaming which depends on the methods used by the underlying web-browser for transport and rendering (integrated player or external player). Another issue is that HTML5 is widely supported by almost all popular browsers and it is expected that the HTML5 specifications will continue to mature in parallel with platform development. Another argument is that HTML5 will break the monopoly of Flash player and other plug-in players. It will also increase semantic coding with advantages like the separation between video/audio tags (though new browsers)

Use of HTML5 is preferred, though concerns about the maturity of the standard are raised by the experts.

On the other hand, the experts supporting the use of HTML5 also have concerns regarding the most crucial part of HTML5 for SARACEN which is the <video> tag; this tag does not meet the project's requirement to have a way to implement proprietary video codecs or P2P distribution application within the browser executing the HTML5.

The experts who do not agree with the use of HTML5, as they characterise it as an under-tested language, present many well based arguments. First of all HTML5 does not cover the requirements of a P2P application. On the other hand adaptive streaming (taking advantage of scalable codec) issues, like H.264/SVC could probably be adopted. Finally, it is worth bearing in mind that HTML5 is not yet compatible with some browsers (Firefox) – although this should change if it is more widely adopted. It is worth mentioning that the BIG boys – like YouTube, Google etc. – are still in the research phase while HTML5 is still in development and it doesn't support plug-ins. There are some doubts whether it is yet mature enough to allow the whole project could be based on it. It is stable enough for a research project but maybe there should be a waiting period of 6-12 months before the final decision is made.

In any case, the above concerns have led to the formation of the special questionnaire and the external expert survey that follow later in this section of the deliverable.

6.4.3 Question 3: Selection of programming platform

Scope and Rational of the question

This question aims to determine experts' beliefs about the programming languages. The purpose is to gather some opinions about which programming language is faster and more reliable in order to decide which of them fits better to the SARACEN platform.

Analysis of results and Conclusions

This question is related to the software development of the SARACEN modules. The answers collected by the experts indicate a slight preference for C++ compared to the rest of languages, with JavaScript and Python following, while Java and .Net collected the fewer preferences.

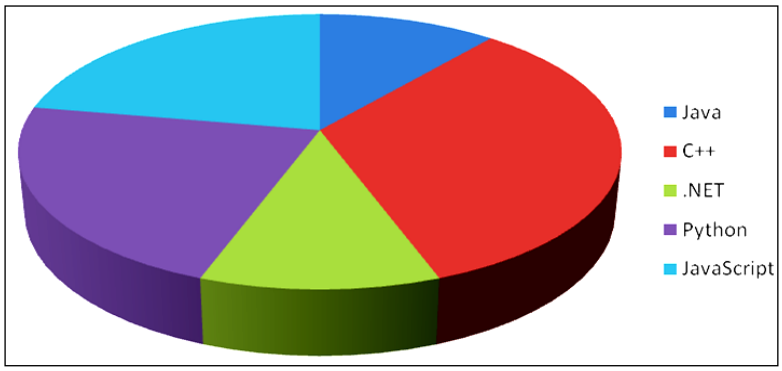


Figure 38: Selection of programming platform

The experts' answers are based mainly on the fact that most of the decoders are written in C/C++ with some parts in assembler language for performance issues; for example C++ is widely used in 3D graphic applications (games etc.) and JavaScript would be needed if the HTML5 route is chosen. Another strong argument in order to develop in C++ is that Tribler, which seems the best candidate from all the P2P platforms for the SARACEN, is based on Python and there is work to be done, if it is chosen to be adapted in P2P.

Furthermore there are proposals for other solutions that are close to C++ like JavaScript and Python. For example Linux developers seem to prefer Python, contrary to the desktops/pc's which use C++ because it can be easily converted to Objective C to use on Mac and iPhone. It has to be noted that the user still needs a server to run the system. A downside of Java is that users should have up-to-date Java on their computer which again lends itself to possibility of user error. Additionally a good point is that the appropriate languages may depend on the target platforms and on the adoption or not of any existing code as a base to start (existing open source platforms/applications).

Use of C++ is preferred by the experts due to the fact that most of the decoders are written in this language while JavaScript and Python could be easily combined with the use of HTML5 if it is adopted by the project.

According to all answers it is evident that JavaScript will be required for the GUI. Python and/or Java will be used for development of web services.

Finally, Java and .Net were considered suitable because they are both standardised cross-platform solutions, and both have support on mobile platforms like Android. Java is a de facto standard controlled through the Java Community Process and .Net platform is standardised through ISO/IEC 23270 (C#) and 23271 (CLI).

6.4.4 Question 4: Re-use of existing P2P platform

Scope and Rational of the question

Using a pre-existing open source platform could save much effort and time rather than starting from scratch. With this question, we can understand how the experts of the project feel about the possibility of using an already existing platform and whether they are able to expand it.

Analysis of results and Conclusions

In this question all experts agree that SARACEN's P2P network has to be based on a mature and well tested open source P2P platform. Of course in order to select the most appropriate one we need to study which one will best fit the project's requirements. One of the most important requirements is the real time media streaming support and the implemented scalability which is inherent in P2P networks.

All experts agree that P2P network has to be based on a mature and well tested open source P2P platform.

Finally there are many proposals about the P2P platforms that could be used like Amazon S3 which could be adapted for the SARACEN's needs – myp2p, stream2stream, Tribler and NextShare.

6.4.5 Question 5: Forecast for use of technologies for scalable and adaptive video coding

Scope and Rational of the question

A very interesting idea is to use MDC, SVC and multiple encoded streams for multimedia distribution over P2P networks. With this question, we can determine what the experts believe about these three types of encoding and whether we should use any of them in the SARACEN platform.

Analysis of results and Conclusions

In this question the experts' opinions are divided. Specifically, Multiple Description Coding is designed for obtaining robustness (even at high loss rates) and not scalability, and has no all-or-nothing behaviour (decoded descriptions all contribute to decoded video quality). MDC will enhance the performance of streaming over P2P networks. It avoids the need to get the packets in some specific order; peers will have more chances to interchange packets. Generally MDC seems to be more promising compared to SVC due to the fact that it requires "base stream" which is essential for decoding. Therefore MDC is proved to be more suitable for P2P networks.

MDC is considered as more promising than SVC especially when used over P2P. However, SVC as an extension of the H.264/MPEG-4 AVC video compression standard, is possible to achieve fine adaptation capability with only 10% overhead.

On the other hand, the experts support also the SVC solution,

as it is thought to allow efficient scalability: layers can be decoded one after the other, starting from the base layer; every layer has different importance and requires prioritisation which may not be available in the network. Both solutions have their advantages and disadvantages but it should be noted that SVC as an extension of the H.264/MPEG-4 AVC video compression standard looks more promising for several client applications, as it is possible to achieve fine adaptation capability with 10% overhead.

Regarding the multiple encoded stream, it is an already well tested technology on the web i.e., http://www.iis.net/media/experiencesmoothstreaming to achieve course adaptation without using a scalable codec.

6.4.6 Question 6: Selection of transfer protocols

Scope and Rational of the question

This question attempts to compare the traditional transfer protocols with the more recent ones. The scope of the question is to find out what the experts believe about the recent transfer protocols and how willing they are to use them instead of using older but commonly used ones.

Analysis of results and Conclusions

Analysis of the results shows that the majority of partners think that the most appropriate layer 4 transfer protocol for the SARACEN P2P network is TCP.

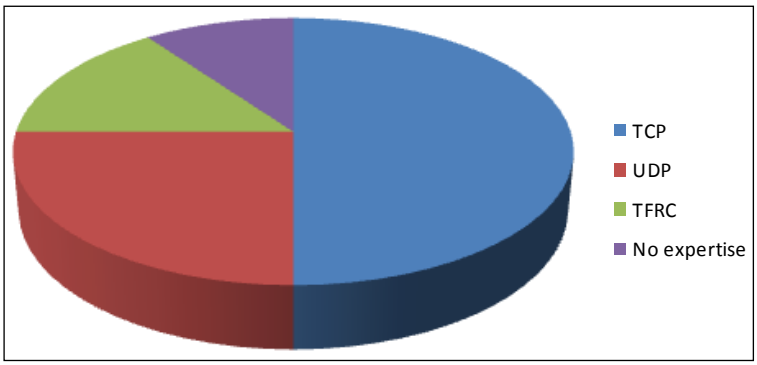


Figure 39: Selection of transfer protocols

Analytically, half of the experts have answered positively for the utilisation of TCP as it is the only protocol that can connect to any other node even if it is behind a NAT router and generally provides an easy firewall crossing. Another advantage of TCP is that it is widely used; it seems reliable and counters many of the bug/rogue attack difficulties. Finally it is supported by every OS.

UDP protocol also seems to be a good option, since it's more suited for real-time traffic than the other protocols. For example the Real Time Protocol (RTP) works in conjunction with UDP. It has been noticed that Windows TCP implementation easily suffers from too small window on long RTT links which reduces throughput.

Use of TCP as a layer 4 solution is preferred by most of the experts, with UDP following due to its inherent link with the use of RTP. DCCP is acknowledged for its advantages but there is skepticism about integration with different OSs.

On the other hand about one third of the experts support DCCP, as it is a protocol that could combine the advantages of TCP, like flow and congestion control and the light nature of UDP with little overhead due to absence of ACK packets. These characteristics make DCCP the most suitable transport protocol for video streaming, as it is a packet based protocol that allows application layer framing (ALF) and it is connection oriented, allowing automated configurations over NAT. But there are a lot of practical issues regarding the usage of DCCP. First of all the DCCP/IP stack has not been implemented in Windows OS, except for some experimental versions from research teams.

Future implementation of DCCP/TFRC in various OSs and the Internet as a whole is not certain and these protocols should therefore be set aside for now.

Finally the TFRC which is a TCP like protocol has not be selected as a candidate protocol from any

partner, as the implementation of TFRC is complicated and it has the same major problem as DCCP; the lack of support from multiple OS.

6.4.7 Question 7: Support for mobility

Scope and Rational of the question

The aim of this question is to examine which technique is preferred by the experts regarding seamless service mobility. Apart from the known protocols and techniques, an effort is made in order to determine if the experts have developed their own methods to achieve this type of service.

Analysis of results and Conclusions

This is a difficult question regarding the most innovative feature of SARACEN as P2P platform; seamless service mobility which is not supported by any other well-known P2P system and especially for real time media streaming. For this reason most of the experts answered that this issue is out of their expertise.

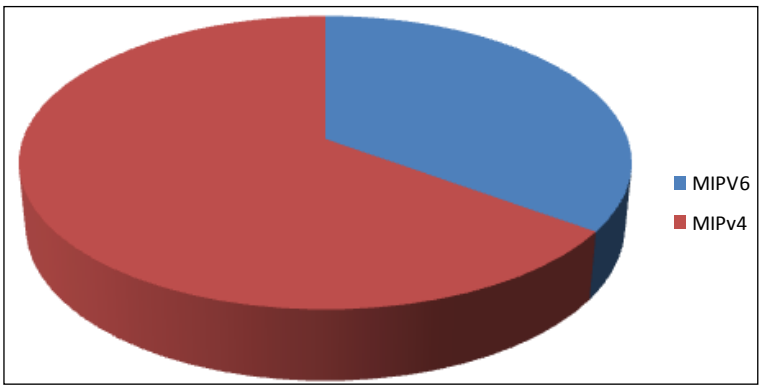


Figure 40: Support for mobility

From the answers of the rest of the experts, the preference for using mIPv6 is obvious. The mIPv6 is a protocol that has been designed to support mobility and roaming across different networks without network overhead as the creation of triangulation or the conventional approaches of mIPv4 and tunnelling. Also tunnelling has a big overhead on the packet load with the encapsulation.

There is a clear preference in the use of mIPv6 as regards the support of mobility.

Finally there is a proposal regarding the usage of SIP, which is a solution for mobility that could be very interesting compared to other mobility techniques, due to its independency of network protocols.

6.4.8 Question 8: Selection of HD analysis

Scope and Rational of the question

Since there are few devices which actually provide a better user experience in 1080p we are trying to determine if our experts believe that it's worth trying to support this analysis, too.

Analysis of results and Conclusions

The analysis of the results shows that two thirds of the experts prefer the utilisation of 720p HD analysis. The strongest argument for supporting this resolution is that 720p is adequate enough for SARACEN, as a trade-off between quality and encoding/decoding complexity. Another very important and more specific technical issue is the decoding of 720p which is extremely challenging especially with SVC.

Support for 720p HD analysis is preferred, as a trade-off between quality and encoding/decoding complexity.

The rest of the partners support the utilisation of 1080p as it is the gold standard for HD and the target for the HD TV of the future.

Unfortunately the 1080p seems to be a dream, although the CPU power and bandwidth have improved enormously. As far as the use case of SVC is concerned, 720p is not reachable even with the strongest CPUs.

6.4.9 Question 9: OS selection

Scope and Rational of the question

OS independency is considered to be a must have for most platforms. In this question experts express their opinions about this issue.

Analysis of results and Conclusions

In this question all the partners unanimously answered that the SARACEN's platform has to be OS independent, due to large variety of OS over the internet and especially for mobile devices that will form a significant part of SARACEN's nodes. It has been suggested that all network elements of SARACEN have to be OS independent from the simple node up to Publishers or Trackers and proportionally to the architecture that we are going to select.

OS independency is supported by the experts answering the questionnaire.

6.4.10 Question 10: Support for trackless mode

Scope and Rational of the question

Trackless mode is a quite useful feature in P2P networks since it reduces the cost of such networks. The experts' opinions were gathered about this feature in order to find out if they believe that it is useful and whether it is worth the time and effort to implement it in the SARACEN platform.

Analysis of results and Conclusions

Many of the experts have not answered (about 50%), while the rest agree that this should not be a priority and that trackless mode will not add anything valuable to the project. Generally trackless mode has been developed out of the necessity to anonymise the identity of the content source which is not among the objectives of the project. Furthermore, as the general feeling is that tracking users can be performed also through the use of cookies, and most machines are set up to do this without the users being bothered, this seems to be not important.

Experts agree that use of trackless mode is not important to the project.

6.4.11 Question 11: Geo-location and minimisation of inter-ISP traffic

Scope and Rational of the question

This question refers to one more technique which enhances the distribution on P2P networks. The scope of this question is to question experts on this topic and to evaluate whether this feature should be added to the SARACEN platform.

Analysis of results and Conclusions

In this question all partners agree that we have to implement an innovative mechanism in order to have the optimum communication link between nodes. The question refers to Geo-Location in order to achieve the best possible group of P2P nodes for content distribution. It is true - as mentioned by some partners - that the geographic distance in an IP network does not guarantee the link quality. This means that Geo-location is not useful for determining the shortest path given specific network traffic. We can consider Cyprus as a clear example. Even though Northern and Southern areas of Cyprus are extremely close geographically, they are not connected with each other. Services which try to optimise traffic routing based on Geo-Location often fail by directing to a mirror located on the opposite side of the island, resulting in traffic actually making a trip through London!

An advanced mechanism for minimisation of inter-ISP traffic going far beyond simple geo-location for improving the communication between nodes should be adopted in the project.

For this reason SARACEN will research IP proximity algorithms in order to continually exploit the best possible group of P2P nodes.

6.4.12 Question 12: Bypassing firewalls and internet limitations

Scope and Rational of the question

Due to the growing traffic that is caused by P2P networks, internet service providers (ISP) apply network limitations on P2P traffic. In this question we ask our experts about ways to avoid these limitations, which is something very important in order to achieve reliability in high quality multimedia distribution.

Analysis of results Conclusions

No clear answer was provided here. Experts expressed the opinion that the protocol should be friendly towards the network provider and actually allow the provider to detect it. Encryption of IP packets, though it could provide the answer, may make it more difficult for ISPs to adopt the platform.

Protocol should be friendly towards the network provider and actually allow the provider to detect it.

6.4.13 Question 13: Addressing NAT problems

Scope and Rational of the question

This question is about network limitations in home networks. In order for the SARACEN platform to be successful it must allow nodes from different home networks to communicate with each other. In this question, experts express their opinions on which is the most appropriate way to achieve such communication.

Analysis of results Conclusions

Regarding the utilised mechanism for P2P node communication behind NAT, all partners suggested several approaches. From the analysis of the results, it seems that NAT Port Mapping and NAT-TCP are the most popular mechanisms. On the other hand well-known solutions like UPnP and Simple Traversal Utilities are also a possible solution for this problem. For example the popularity of UPnP is an important issue, as most NAT routers in IPv4 support UPnP, therefore NAT Port Mapping Protocol (NAT-PMP) can be regarded as a very good choice (supported by most of the P2P applications) and it is a much simpler solution as regards development, taking into consideration that the RFC description has only the 1/10 of the lines that UPnP has. Another option is the Interactive Connectivity Establishment (ICE), which uses Simple Traversal Utilities for NAT (STUN) and Traversal Using Relay NAT (TURN) for setting up media sessions between peer nodes behind NATs (due to the common use of some kind of rendezvous servers for registration, discovery, or relay functions of P2P applications).

NAT Port Mapping and NAT-TCP are the most popular solutions for addressing NAT problems.

This means that in the corresponding deliverable [D6.1], we have to analyse in depth the specification of each mechanism and adapt it according to SARACEN's platform requirements.

6.4.14 Question 14: Use of DRM

Scope and Rational of the question

A controversial issue on P2P networks is that they are used for illegal file sharing. In this question our experts give their opinions on how to prohibit any illegal action on the SARACEN platform, using DRM techniques.

Analysis of results and Conclusions

SARACEN should not be directly involved in DRM, but it should be DRM-friendly allowing "hooks" to be added for DRM. As most DRM efforts have been proven unsuccessful so far and have led to customer dissatisfaction, the best choice for the platform is to be DRM-agnostic, and if it is decided to include such support in the future, this can easily be carried out.

Platform should be DRM agnostic.

6.4.15 Question 15: Use of Devices

Scope and Rational of the question

The trend in state of the art technology development is to integrate “the three screens”, a term which refers to mobile phones, personal computers and televisions. The aim of this question is to identify what the experts feel about this trend and if the SARACEN platform should follow it, providing support to those three types of devices.

Analysis of results and Conclusions

PCs and mobile phones are the devices most likely to be used by CTVC consumers in the target demographic/age group of SARACEN. Mobile is particularly important for young people because of its portability, usability and privacy (personal ownership). For the purposes of this research project, notebooks, mobiles and set top boxes would give a good base for cross system testing – giving several OS’s and scales to work with. Regarding mobile devices we have Windows based terminals, Symbian, Android and the popular iPhone/iPad.
New types of devices are also becoming increasingly popular, such as Set Top Boxes (STBs) and game consoles. Both have proprietary OS and extended multimedia capabilities. As in question 9 related to OS, it seems that SARACEN’s platform has to cooperate with all devices that support IP protocol.

SARACEN should provide support for all devices that support IP connectivity, taking into account their processing and networking capabilities.

6.4.16 Question 16: 3DTV Shipments

Scope and Rational of the question

The aim of this question is the estimation from the experts of the number of 3DTV shipments globally, in 2011.

Analysis of results and Conclusions

Driven by a pronounced change in marketing and promotion strategies as well as price declines and an increasing availability of content, worldwide shipments of 3DTV will be catapulted by a spectacular 463 per-cent to reach 23.4 million units in 2011, according to IHS iSuppli (NYSE: IHS) research.

Global 3DTV shipments will soar by nearly 500 per cent in 2011.

The 3DTV projections in 2011 represent startling growth for the much-publicized technology, with shipments expanding by a factor of 5.5 from 4.2 million units last year. Another year of triple-digit growth is expected in 2012, when shipments will soar by 132 percent to 54.2 million units. Global shipments will breach the 100-million-unit mark by 2014 and then hit 159.2 million in 2015.

Figure 41: Global shipments of 3DTV

"In a major recalibration effort, television brands are changing strategies this year following lukewarm response to 3D in 2010 when consumers balked at the high price of sets and the lack of 3D content," said Riddhi Patel, director for television systems and retail services at IHS. "In 2011, however, brands are marketing 3D not as a must-have technology but as a desirable feature, similar to the approach they have taken with Internet connectivity."

Brands believe this approach to promoting 3D allows consumers to decide whether they wish to use the feature when they are ready, while convincing them that their newly purchased television is future-proofed, Patel noted. This gives consumers the appearance of having the choice to use a feature already present in a purchase that they made, instead of forcing them to buy a technology for which they might be unprepared, according to the television brands.

To further motivate consumers to buy 3DTV, brands are slashing prices. Prices for 3DTV fell 9 percent during March 2011 compared to February, according to the US TV Price and Specifications Tracker, a monthly IHS iSuppli service that tracks U.S. TV prices. Within the next year, prices will shift again, in accordance with the feature mix dictated by public preferences at the moment – a process expected to democratize 3D adoption among consumers in all income brackets.

Broadcasting of 3D also will enjoy an uptake, helping to dispel the public perception of a serious lack in currently available 3D content for consumption. From the launch of 3DTV services in June 2010 for the United States, and then in October the same year for the United Kingdom, more than 80 live sources of 3D broadcast or pay-tv content had been delivered by the end of 2010. More programming will be available this year, topped by sports-related events and then followed by primetime entertainment, films and documentaries.

The 3D TV share of the global flat-panel market will continue to rise in the years to come, jumping to 11 percent in 2011 from 2 percent last year, and then doubling next year to 22 percent. By 2015, 3DTV will account for 52 percent of flat-panel shipments [ISUP].

6.4.17 Question 17: 3DTV Domination

Scope and Rational of the question

The aim of this question is finding out if the consumer electronics is going to be dominated by 3DTV?

Analysis of results and Conclusions

3DTV is going to grow; however, it is going to be trumped by IETV (Internet-Enabled TV). While the consumer electronics headlines last year have been dominated by 3DTV news, the real story in 2010 was about Internet-Enabled TVs (IETVs), according to iSuppli Corp.

SARACEN should be aware that 3DTV is definitively a very important but not necessarily the dominating technology, yielding to IETV.

Global shipments of IETVs – i.e., TV sets with built-in Internet capability – amounted to 27.7 million units in 2010. In contrast, 3D set shipments totalled only 4.2 million that year. While 3D television shipments are set to soar in the coming years, iSuppli's forecast shows the biggest near-term growth story is in IETV.

"Despite aggressive promotions from the industry and intense consumer interest generated by the blockbuster Avatar and other titles, the 3DTV market in 2010 will be limited to a small pool of enthusiastic early adopters", said Riddhi Patel, director and principal analyst for television systems at iSuppli. "In contrast, IETV is entering the mainstream in 2010. This is because 3D is still dealing with a number of barriers, including cost, content availability and interoperability, while IETV provides immediate benefits by allowing TV viewers to access a range of content readily available on the Internet." [ISUP2]

6.4.18 Question 18: 3DTV Displays

Scope and Rational of the question

The aim of this question is finding out what will be the most popular 3DTV display technologies?

Analysis of results and Conclusions

Liquid crystal display (LCD) will remain the dominant technology for the 3DTV market, accounting for 83 percent of 3DTV sold in 2011. In comparison, plasma is a much smaller player. However, 3D penetration in plasma is higher, as the highly touted feature is one that plasma manufacturers hope will help slow the decline of the plasma market [ISUP].

Liquid crystal display (LCD) will remain the dominant technology for the 3DTV market (accounting for 83 percent); however, 3D penetration in plasma is high-

6.4.19 Question 19: 3DTV Glasses

Scope and Rational of the question

The aim of this question is finding out what will be the most popular 3DTV glasses technologies?

Analysis of results and Conclusions

While the current active shutter glasses provide better picture quality, an alternative known as passive Film Patterned Retarder (FPR) not only will expand availability in sizes as small as 32-inches, but also will reduce the overall cost of ownership, with the glasses being more user friendly as well. By 2015, passive 3D shipments will surpass those of active 3D, IHS expects [ISUP].

The current active shutter glasses technology provides the best picture quality.

6.4.20 Question 20: 3DTV Size

Scope and Rational of the question

The aim of this question is finding out what will be the most popular 3DTV sizes?

Analysis of results and Conclusions

The most popular 3DTV size during 2011 will be in the 40- to 41-

The most popular 3DTV display size is the 40- to 41-inch range.

inch range, numbering about 3.3 million units; followed by the 55- to 59-inch range, with shipments of 2.9 million units; and the 45- to 46-inch range, with 2.7 million units [ISUP].

6.4.21 Question 21: Mobile 3D

Scope and Rational of the question

The aim of this question is finding out if there is a sense of setting up solutions for mobile 3D, finding out if this is a "cool" feature as well as if experts really see the future of such a solution in a mobile telephone?

SARACEN should try to cover mobile devices such as the early 3D adopters from the mobile devices generation like LG Swift 3D / LG Optimus 3D.

Analysis of results and Conclusions

The votes "for": 63.3%.

The votes "against": 36.7%.

According to a survey that took place in July 2011 for website: [Mob].

6.5 External experts' survey (HTML5)

In this section, the external experts' survey as regards the possibility of use of HTML5 is presented. The corresponding questions are reported, together with a presentation and analysis of the answers provided, while a corresponding section with conclusions taking into account the answers given by both the end-users and the experts in the internal experts' survey is provided at the end.

6.5.1 Question 1: Support for adaptive streaming

Scope and Rational of the question

This question tries to identify the particular provisions of HTML5 standard as regards the transmission of video (if any). Furthermore, as this is of interest to the project, the question tries to identify if there are provisions regarding adaptive streaming of content.

Analysis of results and conclusions

There is indeed nothing specific in the <video> tag for the transmission of video. That doesn't necessarily mean that only progressive download is applied. It all depends on the protocol used underneath. In practice, all browsers will support progressive download. Furthermore, given the rapidly rising importance and market-attention to HTML5 video, it is also likely that they will add support for "more intelligent (adaptive)" solutions than progressive download.

Coming to commercial implementations, Microsoft Smooth Streaming already supports streaming to the iPhone using the HTML5 **<video>** tag and the HTTP Live Streaming protocol [IIS]. Moreover, the container format of the WebM project recently open-sourced by Google, which includes the VP8 video codec, is based on the Matroska file format. This container format also provides features for adaptive streaming [Matroska]. Finally, support for WebM videos in the HTML5 **<video>** tags is announced for Opera, Firefox and Google Chrome browsers.

6.5.2 Question 2: Support for custom codecs

Scope and Rational of the question

This question tries to identify the possibility that HTML5 standard could support not only built-in but also custom video codecs. Moreover, the use of a custom scalable video decoder is beyond the scope of the project, and this question examines this possibility.

Analysis of results and conclusions

Since it is the browser's responsibility to support a particular container and a codec and since there are no restrictions on the <video> codec, we could say that we can add a custom codec as long as browsers support the corresponding decoder. Browsers must integrate a specific video player (decoder) in order to be able to play a video encoded in the corresponding encoder. Therefore, one solution is the implementation and integration of a plug-in into the browser. In addition, browsers may also provide ac-

cess to codecs installed by the underlying operating system. For instance, Microsoft has declared that Google's VP8 codec would be available in Internet Explorer 9 if the user added the codec to Windows [HTML5].

6.5.3 Question 3: Support for P2P video distribution

Scope and Rational of the question

This question tries to identify if P2P video distribution is possible in the HTML5 standard.

Analysis of results and conclusions

In short, the Web sockets API cannot be used to establish persistent direct connections between clients. Connections have to go through HTTP servers. Moreover, the WebSocket API and protocol are currently limited to sending/receiving text frames. This means that binary data needs to be encoded as strings before they may be exchanged. That may not be optimal for video content. Support for binary frames is still under discussion both for the protocol in the Network Working Group at IETF and the HTML working group at W3C. Proper peer-to-peer connections for video was dropped from HTML5 due to lack of interest from browser vendors and was moved to a separate specification called HTML Device [DEVw3]. It is not under active development for the time being, but contributions are welcome.

6.5.4 Question 4: Support for DCCP

Scope and Rational of the question

The aim of this question is to identify whether the DCCP protocol is supported in HTML5 standard. It is in the interest of the project to identify which protocols can be used in HTML5.

Analysis of results and conclusions

HTML5 does not impose using a specific transport protocol, so the theoretical answer is yes. The current trend seems rather to lean towards using regular HTTP over TCP to exchange the video on the Web, partly to take advantage of Content Delivery Networks (CDN) to cache the content, and partly to avoid running into firewall issues. On the other hand, it is not known whether support for DCCP is a high priority topic in the list of functionalities that Web browsers vendors intend to add. One way to raise awareness on DCCP among browsers vendors could be to contribute code to those who are open-source, and in particular to WebKit (at the basis of Safari, Google Chrome and many mobile Web browsers) or Mozilla.

6.5.5 Question 5: Future support for scalable video coding

Scope and Rational of the question

In this question, we are trying to identify whether the HTML5 standards intend to support scalable video coding. The use of scalable video coding is in the aim of the project, since it enhances video distribution.

Analysis of results and conclusions

Browsers with an SVC decoder would indeed support a video, encoded in SVC format. SVC is available as an extension to H.264, which requires support for the appropriate profile of H.264 (3 possible profiles). Web browsers that started to add support for HTML5 videos stick to the Baseline profile of H.264 (potentially combined with the “adaptive streaming” technique mentioned above) currently. This is particularly true for mobile devices such as iPhone and Android devices. However, Google deployed the Gmail Video chat on a large scale using SVC through a plug-in [Juberti]. This is an active area of research and development, still open to contributions and innovation.

6.5.6 Question 6: Use of C++

Scope and Rational of the question

This question tries to identify whether HTML5 standards will support the integration of external code. This can be useful in case scalable video coding is be used.

Analysis of results and conclusions

Plug-ins can be written in C/C++. Some instances can be found in Apple's documentation for WebKit [Webkit] and Mozilla documentation [Mozilla]. Another option is to create a new version of one of the open-source browsers adding codes support. This approach is for instance taken by the Wild Fox [Wild-fox] project which aims at providing builds of Firefox with H.264 support.

6.5.7 Question 7: Definition of standard (time plan) and support for custom codecs

Scope and Rational of the question

In this question we are trying to identify whether HTML5 standards will support external codecs.

Analysis of results and conclusions

HTML5 does not mandate any codec for the time being. Even if it does, it will certainly leave the door open to other codecs.

6.5.8 Question 8: Size adjustment

Scope and Rational of the question

In this question we are investigating if it is possible for the player to interact with the video content on the fly in order to achieve a better performance.

Analysis of results and conclusions

It is possible to set the resolution of the on-screen video player through JavaScript (although full screen needs to be explicitly activated by the user) and that can be based on the intrinsic size of the video, made available to the script in HTML5, even if these dimensions change on the fly.

6.5.9 Question 9: Utilisation of HTML5 capabilities

Scope and Rational of the question

The aim of this question is to identify how useful HTML5 can be to the SARACEN project, in other words, to which extent the capabilities of HTML5 can be used by the project.

Analysis of results and conclusions

The geolocation API is already well implemented in Web browsers (e.g. Safari, Firefox, iPhone, iPad, Android, WebOS) and is ready to be used. Regarding accessibility, W3C standards are always designed with accessibility in mind. There are also ongoing discussions within the HTML WG about accessibility, in particular about accessibility of videos and support for subtitles. In addition, HTML5 makes the video element available for scripting and, in particular, the video player interface is ready to be entirely customised to suit anyone's needs. About subtitles, in a nutshell, the question is whether the Timed Text Mark-up Language [TR- ttaf] will be used or whether browsers will prefer to implement a format based on HTML and CSS, along with timing attributes. They may also support subtitles that use the SubRip Subtitle Text (SRT) [Fileinfo] format, commonly supported by media players. Finally, works on Accessible Rich Internet Applications (WAI-ARIA) should also be considered to create rich and accessible user interfaces [TR-wai].

6.5.10 Question 10: Codec declaration

Scope and Rational of the question

This question refers to video codecs and is trying to identify if there is a way in order the browser to determine which codec is needed for each video and if this codec is already installed.

Analysis of results and conclusions

The HTML5 video tag element can accept as a parameter the needed codec for the video [DEVW3TSE]. Furthermore, JavaScript can be used to determine whether the browser supports the needed codecs [DEVW3MIME].

6.5.11 Question 11: Execution of RIAs

Scope and Rational of the question

This question aims to determine the capabilities that HTML5 will support regarding RIA and media rich user interfaces.

Analysis of results and conclusions

The HTML5 video tag element can be manipulated like any other HTML element. JavaScript and CSS can be used to manipulate the appearance of a video, e.g. through the use of CSS transformations [DEVW3CSS]. In addition, it can be displayed as an overlay. There is also nothing that prevents other elements from being displayed as overlays over the HTML5 video tag element, for example the Video player demo [DEVW3Talks]. However, it may not be possible in practice to overlay elements on top a video if the video player uses hardware acceleration while the rendering of the other HTML elements is handled by software.

6.5.12 Question 12: Use of P2P functionality without the need for a plug-in

Scope and Rational of the question

This question tries to identify the possibility of using only HTML5 standards to create P2P applications. This is within the scope of the project, since the SARACEN project is dealing with subjects relevant to online content distribution over peer to peer networks.

Analysis of results and conclusions

See question 3 above for restriction on text vs. binary and on the fact that connections have to go through a server, which may or may not be enough depending on the application's needs. The application would be browser independent otherwise.

7 Complementing user requirements with real word experience and the use of standards

Concluding the task of user requirements capturing and in order to be able to compile the results, a comprehensive table of requirements including topics that are of particular interest to the project was created. In these topics, the answers collected by the tools used were not considered adequate so as to fully describe the requirements of SARACEN. For these issues, we asked the opinions of experts, based on their knowledge of the subject and also their previous experience from similar developments.

In the following paragraphs, the findings of this survey among experts for particular issues are presented and discussed. The categories chosen are the following:

- Peer to Peer
- Costs and Rights
- Usability
- Devices

7.1 Peer to Peer

Here, the extraction of requirements based on the expertise and ideas of experts is a simple task. Since a report on the issue of P2P has already been provided earlier in the deliverable, this subsection presents the conclusions in bullet-points:

- The system shall preserve user privacy and protect the communications between peers from eavesdroppers.
- The system shall not preclude running of several P2P clients on the same Home Network (behind NAT)
- Users shall be able to create and distribute their own content as well as consume content from multiple providers.
- It shall be possible to restrict access to user content or provider content even to authorised peers.
- It shall be possible to restrict the ability to identify user content or provider content even to authorised peers.

7.2 Issues related to Costs and Rights

Many countries around the world recognise that broadcasters hold a property right in their content-carrying broadcast signals, independent of the copyright in the underlying content. The purported justification for these rights derives from the need to equip broadcasters with mechanisms to prevent others from free-riding on their investment of time, skill and effort. Structured analogously to traditional copyright, these “broadcasters’ rights” (together with certain others) are often characterised as “neighbouring” or “related” rights.

Broadcasting rights change from country to country and even within provinces of countries and can also be restricted to allowing a broadcaster the rights to distribute that content for a limited time.

Broadcasting rights change from country to country and even within provinces of countries. These rights govern the distribution of copyrighted content and media and allow the sole distribution of that content at any one time. An example of programmes only being aired in certain countries is BBC iPlayer. Users can only stream content from the BBC iPlayer from Britain because the BBC only allows free use of their product for users within the United Kingdom because those users pay a TV license to fund part of the BBC. Broadcasting rights can also be re-

Broadcasters **replicate** several of the copyright holders’ exclusive privileges, and they have rights to authorise the reproduction of fixations, and consciously contemplate a multiplicity of lawsuits for a single act of infringement.

stricted to allowing a broadcaster the rights to distribute that content for a limited time.
Broadcasters' rights extend beyond the right to broadcast to actions post-fixation. In other words, they replicate several of the copyright holders' exclusive privileges, but through the broadcast. Given the inseparability of the signal from its underlying content, they translate into rights over the content. Thus, the broadcaster's exclusive right to authorise the reproduction of fixations means little more than the right to authorise the reproduction of the content of the broadcast – a right that is vested in the content producer. A user reproducing content obtained via a broadcast is now subject to two potential lawsuits – one from the copyright-holder, and another from the broadcaster. Whereas avoiding multiple lawsuits remains central to the rules surrounding copyright licensing, the broadcasters' rights regime *is directed* at creating an additional right to sue. Broadcasters' rights thus do much more than just *move* the entitlement from the content producer to the broadcaster, they *replicate* it. If an authorization from the broadcaster (i.e., the distributor) were to alleviate the need for a similar/equivalent one from the content producer and vice-versa, such that consent from either would immunise a user from liability, the decision-making structure then becomes truly polyarchical. Broadcasters' rights however consciously reject such a model (of decentralised authorization), in the legitimate belief that so doing would undermine the content holders' contribution, central to the entire creative process. In so doing, they thus contemplate a structure that is distinctly hierarchical; detracting from the possibility of there being any structural efficiency gains. The efficiency argument thus fails on three fronts. First, broadcasters' rights go far beyond the ideal of minimising broadcasters' costs of contracting for similar rights, simply because broadcasters couldn't have contracted for such rights to begin with (except by acquiring the copyright in its entirety). Second, they do not effect a mere re-allocation of the entitlement. Instead, they replicate the entitlement and consciously contemplate a multiplicity of lawsuits for a single act of infringement. Third, the efficiency argument ignores the fact that transaction costs exist on both sides of the equation. Even if the regime minimised broadcasters' transaction costs, it multiplies users' costs by now requiring them to navigate through an additional layer of liability. Broadcasters argue that with the advent of new technologies of digital copying, unauthorised interception, fixation and retransmission of broadcasts has become rampant.

> The broadcast chain (content producers, followed by broadcasters, then cable companies) are each interested in controlling the revenue streams associated with their contribution to the process

Studies (undertaken by broadcasters' collectives) showed a 150% increase in television piracy in 2004; that 7% of all broadcast piracy occurred in the United States; and the revenues losses from signal theft globally amounted to approximated $ 2 billion. The emergence of the Internet as a distribution medium and its transnational nature, it is claimed, further diminishes broadcasters' revenues. Television stations are in turn of two kinds – affiliates and independents. Affiliates are television stations that are *affiliated* with an individual network. Affiliates receive almost all their programming from the networks and most often affiliates in the same time zone receive identical programming packages. However, within each geographic market, an affiliate is granted a certain degree of exclusivity in carrying the program. Independents are local television stations just like NTV that aren't affiliated with any network. This being the case, their primary source of programming comes from producers in the syndication market. This market is generally regarded as the secondary market for television programs. Broadcasts, cable companies and content producers are each interested in controlling the revenue streams associated with their contribution to the process. While content producers' contribution is by far the most significant (and therefore seemingly worthy of the most extensive protection), broadcasts and cable companies partake in the distribution process, which is equally important. The broadcast chain – commencing with content producers, followed by broadcasters, then cable companies – before reaching the audience, involves the contributions of different players at each successive stage and the question becomes the extent to which an exclusionary right (or protection) provided is to be tailored to enabling the internalization of revenues associated with the exact contribution and no more.

> Broadcasters are losing huge amount of revenues due to piracy and unauthorised retransmission of broadcasts, the emergence of video over internet will extend the problem

7.3 Usability

The definition for usability when referring to user interfaces is *"the perception of a target user of the effectiveness (fit for purpose) and efficiency (work or time required to use) of the interface"* [WikipediaUsability].

Usability is an example of a non-functional requirement. As with other non-functional requirements, usability cannot be directly measured, but must be quantified by means of indirect measures or attributes such as, for example, the number of reported problems with ease-of-use of a system. Each component may be measured subjectively against criteria like the Principles of User Interface Design, to provide this metrics or statistics.

7.3.1 User Centred Design (UCD)

There is an international standard that should be the basis for every User Centred Design (UCD) methodology. This standard is provided by the International Organization for Standardization (ISO) and it is "ISO 9241-210:2009. (Ergonomics of human system interaction - Part 210: Human-centred design for interactive systems)" (formerly known as 13407). It defines a general process for including human-centred activities throughout a development life-cycle, but does not specify exact methods. The phases of the cycle are represented in next figure, and the process ends once the requirements are met. [UPAUCD]

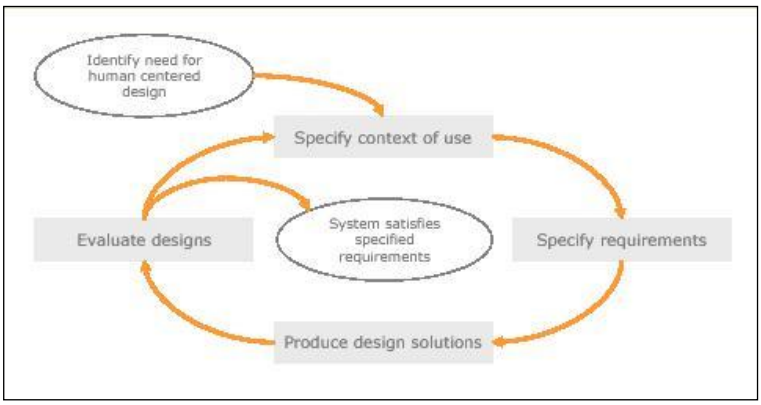


Figure 42: Phases of UCD life-cycle (Source: UPA)

7.3.2 User-centered design methodology

There are various user-centered design methodologies which are more detailed in suggesting specific activities than the ISO 9241-210. For example, the American Usability Professionals Association's methodology broke the development process into four phases: Analysis, Design, Implementation and Deployment, with suggested activities for each phase [UPAUCD]

> The SARACEN interface design must follow the KISS principle: "Keep It Short and Simple". Simplicity should be a key goal in design; unnecessary complexity should be avoided

Analysis Phase

- Meet with key stakeholders to set vision
- Include usability tasks in the project plan
- Assemble a multidisciplinary team to ensure complete expertise
- Develop usability goals and objectives

- Conduct field studies
- Look at competitive products
- Create user profiles
- Develop a task analysis
- Document user scenarios
- Document user performance requirements

Design Phase

- Begin to brainstorm design concepts and metaphors
- Develop screen flow and navigation model
- Do walkthroughs of design concepts
- Begin design with paper and pencil
- Create low-fidelity prototypes
- Conduct usability testing on low-fidelity prototypes
- Create high-fidelity detailed design
- Do usability testing again
- Document standards and guidelines
- Create a design specification

Implementation Phase

- Do on-going heuristic evaluations
- Work closely with delivery team as design is implemented
- Conduct usability testing as soon as possible

Deployment Phase

- Use surveys to get user feedback
- Conduct field studies to get info about actual use
- Check objectives using usability testing

Notice that the term “usability testing” appears several times throughout the process.

7.3.3 Usability testing: usability inspection and heuristic evaluation

Usability inspection methods are generally considered to be cheaper and easier to implement than testing on users. Usability inspection detects a great percentage of the most common problems in the usability of the user interface.

Usability inspection is the generic name for a set of methods that are all based on having evaluators which inspect a user interface. Usability inspection is a review of a system based on a set of guidelines. Typically, usability inspection is aimed at finding usability problems in the design, though some methods also address issues like the severity of the usability problems and the overall usability of an entire system. The review is conducted by an expert or group of experts who are deeply familiar with the concepts of usability in design. The experts focus on a list of areas in design that have been shown to be troublesome for users.

Usability inspection most common methods are:

- Heuristic evaluation is the most informal method and involves having usability specialists’ judge whether each dialogue element follows established usability principles (the "heuristics").

- Heuristic estimation is a variant in which the inspectors are asked to estimate the relative usability of two (or more) designs in quantitative terms (typically expected user performance).
- Cognitive walkthrough uses a more explicitly detailed procedure to simulate a user's problem-solving process at each step through the dialogue, checking if the simulated user's goals and memory content can be assumed to lead to the next correct action.
- Pluralistic walkthrough uses group meetings where users, developers, and human factors people step through a scenario, discussing each dialogue element.
- Feature inspection lists sequences of features used to accomplish typical tasks, checks for long sequences, cumbersome steps, steps that would not be natural for users to try, and steps that require extensive knowledge/experience in order to assess a proposed feature set.
- Consistency inspection has designers who represent multiple other projects inspect an interface to see whether it does things in the same way as their own designs.
- Standards inspection has an expert on an interface standard inspect the interface for compliance.
- Formal usability inspection combines individual and group inspections in a six-step procedure with strictly defined roles to with elements of both heuristic evaluation and a simplified form of cognitive walkthroughs.

Heuristic evaluation, heuristic estimation, cognitive walkthrough, feature inspection, and standards inspection normally have the interface inspected by a single evaluator at a time (though heuristic evaluation is based on combining inspection reports from a set of independent evaluators to form the list of usability problems and heuristic estimation involves computing the mean of the individual estimates). In contrast, pluralistic walkthrough and consistency inspection are group inspection methods.

Many usability inspection methods are so easy to apply that it is possible to have regular developers serve as evaluators, though better results are normally achieved when using usability specialists. [UPAGuidelines], [WikipediaUsabilityMetCom]

7.3.4 Heuristic Evaluation in detail

Heuristic evaluation is a usability engineering method for finding and assessing usability problems in a user interface design as part of an iterative design process. It involves having a small set of evaluators examining the interface and using recognised usability principles (the "heuristics"). It is the most popular of the usability inspection methods, as it is quick, cheap, and easy.

Heuristic evaluation was developed to aid in the design of computer user-interface design. It relies on expert reviewers to discover usability problems and then categorise and rate them by a set of principles (heuristics.) It is widely used based on its speed and cost-effectiveness.

Jakob Nielsen's list of 10 heuristics the most commonly used in industry. These are ten general principles for user interface design. [NielsenHeuristics]

- Visibility of system status: The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
- Match between system and the real world: The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
- User control and freedom: Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
- Consistency and standards: Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

- Error prevention: Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.
- Recognition rather than recall: Minimise the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.
- Flexibility and efficiency of use: Accelerators—unseen by the novice user—may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
- Aesthetic and minimalist design: Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.
- Help users recognise, diagnose, and recover from errors: Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
- Help and documentation: Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

The usability of a device can be determined by determining which guidelines are violated,

7.3.5 Accessibility

Accessibility is strongly related to universal design and UCD. Universal design refers to a broad-spectrum solution that produces buildings, products and environments that are usable and effective for everyone, not just people with disabilities, so in a way it extends the “usability” concept. Accessibility is about making things accessible to all people (whether they have a disability or not).

In human-computer interaction, computer accessibility refers to the accessibility of a computer system to all people, regardless of disability or severity of impairment. It is largely a software concern; software designers have to consider standards to produce applications that enable the use of a computer to every person, independently of any possible impairment or disability, and any special device (Assistive Technology) that they have to use. [WikipediaComputerAccessibility]

Web accessibility refers to the practice of making websites usable by people of all abilities and disabilities. When sites are correctly designed, developed and edited, all users can have equal access to information and functionality. Some examples could be:

- When a site is coded with semantically meaningful HTML, with textual equivalents provided for images and with links named meaningfully, this helps blind users using text-to-speech software and/or text-to-Braille hardware.
- When text and images are large and/or enlargable, it is easier for users with poor sight to read and understand the content.
- When links are underlined (or otherwise differentiated) as well as coloured, this ensures that color blind users will be able to notice them.
- When clickable links and areas are large, this helps users who cannot control a mouse with precision.
- When pages are coded so that users can navigate by means of the keyboard alone, or a single switch access device alone, this helps users who cannot use a mouse or even a standard keyboard.
- When videos are closed captioned or a sign language version is available, deaf and hard of hearing users can understand the video.

- When flashing effects are avoided or made optional, users prone to photoepileptic seizures caused by these effects are not put at risk.
- When content is written in plain language and illustrated with instructional diagrams and animations, users with dyslexia and learning difficulties are better able to understand the content.
- When sites are correctly built and maintained, all of these users can be accommodated while not impacting on the usability of the site for non-disabled users. [WikipediaWebAccessibility]

Software accessible in ISO

The ISO 9241 series ("Ergonomics of Human System Interaction") provides guidance on the design of software that is accessible and connects and interacts with supporting tools of assistive technology. Designers of software are specially affected by ISO 9241-20:2008 "Accessibility guidelines for information/communication technology (ICT) equipment and services" and ISO 9241-171:2008 "Guidance on software accessibility". It also references the W3C's Web Content Accessibility Guidelines.

ISO 9241-20:2008: This part of ISO 9241 is one of the introductory parts which apply to both hardware and software and aims to improve accessibility for use at work, in the home, and in mobile and public environments.

It covers the design and selection of equipment and services for all the people even those with a wide range of sensory, physical and cognitive abilities, including those of us who could be temporarily disabled, and the elderly. It contains general recommendations on:

- Managing development of accessible ICT equipment and services
- User characteristics (Vision, Hearing, Speech, Physical capabilities, Cognitive capabilities)
- Task characteristics
- Equipment and service characteristics
- Environmental characteristics.

ISO 9241-171:2008: This standard is aimed at software designers and provides guidance on the design of software to achieve as high a level of accessibility as possible. It replaces the earlier Technical Specification ISO TS 16071:2003 – Guidance on accessibility for human-computer interfaces and follows the same definition of accessibility - 'usability of a product, service, environment or facility by people with the widest range of capabilities'. It applies to all software, not just web interfaces. The key contents are:

- Rationale and benefits of implementing accessibility
- Principles for designing accessible software
- Sources of variation in user characteristics
- General guidelines and requirements including compatibility with assistive technology
- Inputs including keyboards and pointing devices
- Outputs including visual, audio and tactile outputs
- On-line documentation, "Help" and support services.

Web accessibility in ISO and WAI-W3C accessibility guidelines

ISO 9241 is also relevant to designers of web interfaces, in particular ISO 9241-171:2008 "Guidance on software accessibility", described in the previous paragraph. It also references the W3C's Web Content Accessibility Guidelines.

As stated in section 6.5.9.2, the SARACEN system should follow WAI-W3C accessibility guidelines (WCAG 2.0). This is a summary of general recommendations of WCAG 2.0:

- Perceivable
    - Provide text alternatives for non-text content.

- Provide captions and alternatives for audio and video content.
- Make content adaptable; and make it available to assistive technologies.
- Use sufficient contrast to make things easy to see and hear.

- Operable
  - Make all functionality keyboards accessible.
  - Give users enough time to read and use content.
  - Do not use content that causes seizures.
  - Help users navigate and find content.
- Understandable
  - Make text readable and understandable.
  - Make content appear and operate in predictable ways.
  - Help users avoid and correct mistakes.
- Robust
  - Maximise compatibility with current and future technologies. [W3CWCAG20QuickRef]

The next 10 basic accessibility recommendations were prepared for WCAG 1.0, but are still good recommendations to start with web accessibility - even if they are not complete for interactive applications:

1. **Images & animations:** Use the **alt** attribute to describe the function of each visual.
2. **Image maps.** Use the client-side **map** and text for hotspots.
3. **Multimedia.** Provide captioning and transcripts of audio, and descriptions of video.
4. **Hypertext links.** Use text that makes sense when read out of context. For example, avoid "click here."
5. **Page organization.** Use headings, lists, and consistent structure. Use **CSS** for layout and style where possible.
6. **Graphs & charts.** Summarise or use the **longdesc** attribute.
7. **Scripts, applets, & plug-ins.** Provide alternative content in case active features are inaccessible or unsupported.
8. **Frames.** Use the **noframes** element and meaningful titles.
9. **Tables.** Make line-by-line reading sensible. Summarise.
10. **Check your work.** Validate. Use tools, checklist, and guidelines at http://www.w3.org

For the process of development during the SARACEN project, please refer to [ISO9241], [W3CWCAG20Tech] and [W3CWCAG20QuickRef].

Books like [LynchHorton] and [Duckett] are strongly recommended as tutorials if the SARACEN project needs the development of any web application while [AccessifyForum] is recommended to ask for doubts about accessibility to other developers.

7.4 Devices

This subsection discusses PC-Web site usability, accessibility as well as 3D devices.

7.4.1 PC - Web site usability and accessibility

ISO 9241-151:2008 provides guidance on the human-centred design of software Web user interfaces with the aim of increasing usability. The recommendations given in this part focus on the following aspects of the design of Web user interfaces: high-level design decisions and design strategy; content design; navigation and search; content presentation.

Web user interfaces are presented on a personal computer system, mobile system or some other type of network-connected device. While the recommendations given in this part of ISO 9241:2008 apply to a wide range of available front-end technologies, the design of mobile Web interfaces or smart devices could require additional guidance not within its scope; neither does it provide detailed guidance on technical implementation nor on issues of aesthetic or artistic design.

This part of ISO 9241 presents detailed design principles for designing usable web sites. The standard covers five areas:

- High-level design decisions and design strategy: What is the purpose of the site and how is this made clear to its users? Who are the users and what are their goals?
- Content design: What is the site's conceptual model? How is content organised and how should the site deal with issues such as privacy and personalisation?
- Navigation and search: How should the content be organised so that users can navigate the site easily? How will users search the content of the site?
- Content presentation: How should the individual pages be designed so that people can make use of the information? How should links be designed?
- General design aspects: how should you design for an international audience? How should you provide help? What download times are acceptable?
- Some practical recommendations about website usability are:
- Your website must be consistent and easy to navigate
- Test your website under different operating systems, browsers (and browser versions) and scroll resolutions!
- Take care about internationalisation
- Add ALT and TITLE to your images
- Correct spelling in your content
- Verify that your links work. Use appropriate texts to define your links
- Be careful with the contrast between fonts and background
- Give alternatives to your JavaScript effects
- Don’t underestimate the importance of conventions: Users have gradually become accustomed to particular layouts and phrases on the Internet. Some examples:
    - The logo is in the top-left corner and links back to the homepage
    - The term ‘About us’ is used for organisation information
    - Navigation is in the same place on each page and adjacent to the content
    - Anything flashing or placed above the top logo is often an advertisement
    - The term ‘Shopping cart’ is used for items you might wish to purchase
- Pages must download quickly
    - Do not use images to display text
    - Use CSS and not tables to lay out your web page
    - Use CSS and not images to create fancy navigation items
    - Put CSS and JavaScript in external files
    - Remove unnecessary meta content
    - Minimise comments and blank spaces in your code

- Use “/ “at the end of directory links (Do this : <a href="http://www.URL.com/directoryname/">

- Make information easy to retrieve, In texts consider to use
  - Headings
  - Link text
  - Bold text
  - Bulleted lists
- Don’t prevent your users from navigating through the Internet in the way that they want to. Avoid to open unnecessary windows because you will lose the back button possibility
- Avoid the use of frames to lay out your website as they can cause problems:
  - Disabling the back button
  - Bookmarking not possible
  - Impossible to e-mail the link to someone else
  - Problems with printing
  - Users feel trapped if external links open in the same window
  - Search engine optimisation issues

This list does not pretend to be an exhaustive list of usability recommendations; SARACEN designers are encouraged to study references in bibliography.

Mobile & handheld usability testing – basic principles

If the SARACEN design is oriented to be used in handheld devices via web, it is smart to build a dedicated mobile site[3] [NielsenWebMobileUsability].

We must notice that the number of people accessing the Internet from mobile and handheld devices is increasing at a massive rate[4] [ETForecast]. People generally have a lot less experience of using their mobile devices for Internet browsing than they have of doing the same with a PC. In addition to this, computer-based site visitors generally only differ from one another in their browser and operating system; on the other hand, smartphones can differ from one another dramatically, and this will radically change how people experience and use web applications.

Therefore, from the HCI point of view, mobile and handheld usability testing could be even more important than computer-based usability testing.

Which smartphones do you need to consider?

Because the smartphone that someone is using will have such a deep effect on his/her experience of your site, you should try to test with as many smartphones as possible. As testing with every smartphone is impossible, here are some ideas to help narrow down the number of devices you'll need to test with:

- Decide if your mobile site visitors belong to a specific audience. Certain audiences tend to prefer particular types of smartphones (e.g. phones with big screens that are designed to support online access vs. small-screen models that aren't).
- There are 'phone families' that offer a very similar user experience (and will not need to be tested individually). To organise this families, consider devices with a number of different characteristics attending to:

[3] A Jakob Nielsen’s study notices that users of sites specifically designed for mobile devices improved user performance by 1/5.

[4] For example, the estimation of purchasing of PDA for 2008 was 58 million PDAs sold worldwide.

- Screen size and pixel density (pitch). Modern smartphones have screens starting from 176x208 (Symbian S60 standard resolution) to the 640x960 of Apple iPhone 4. Another characteristic to consider is the pitch of the screen. Mobile devices are going to have a higher pixel density than computer monitors. The same assets will appear smaller on phones with large pitch like the 326ppi screen of Apple iPhone 4.

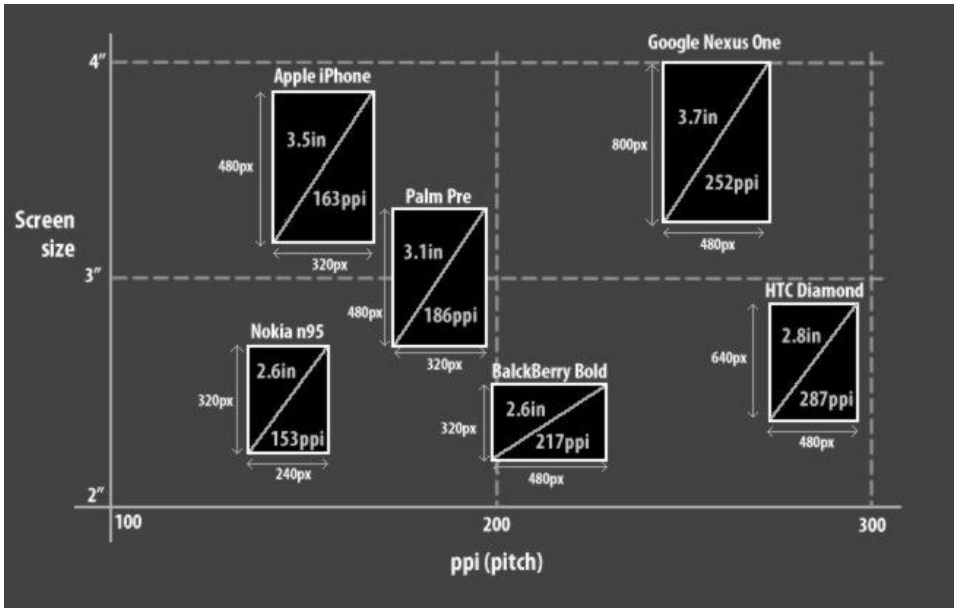


Figure 43: Screen sizes and pixel density in smartphones. [AdobeRIAMobile]

- Screen layout (portrait vs. landscape)
- Input device (stylus, numeric keypad, dial-wheel, QWERTY keypad)

Figure 44: Different input devices [Figueiredo]

- Operating System (you cannot see Flash in the Apple iPhone, JavaScript does not work in Windows CE models)

Figure 45: Main mobile platforms. [Nusca]

- You may only want to test with the most popular mobile phones in Europe or the most popular models that are being used to access your site (you can check your site statistics to find out this information). [WebcredibleMobileUsability]

10 Best practices when designing mobile applications [Figueiredo]

- Easy to type addresses m.site.com or site.mobi instead of www.site.com/mobile
- Specialised mobile versions
- Use hierarchical navigation
- Design for big fingers and for 5-key navigation.
- Avoid putting too much information on the screen
- Use scrolling only for data that can't be broken in several pieces
- Avoid repetitive data entry passwords are hard to type
- Minimise the battery and bandwidth use. Assume the network is slow.
- Make the application aware of interruptions.

Things to bear in mind during handheld usability testing sessions [WebcredibleMobileUsability]**:**

- **Experience of your users** when accessing services using their mobile phones. Consider that the percent of 'complete novices' (i.e. people using the technology for the first time) will be far higher than for computer users of your website.

- **Do the tests with real phones.** Certain issues won't arise in phone emulators,
- **Which smartphone they own**. It is highly recommended that people use their own mobile phone in your usability testing sessions, so the test can focus on your website and not on the way the handheld device works.
- Where**, when and how a mobile phone is used.** Smartphones are used in the real world so usability testing of handheld devices should therefore not only take place in a usability laboratory. It is recommended that any mobile device usability testing is conducted both in a laboratory and also in the 'outside world'. The following circumstances should be considered:
    - Lighting
    - Background noise
    - Distractions
    - Concurrent tasks (i.e. anything the person is doing at the same time)
    - Physical movement
- Mobile usability testing methodology: the most popular methods include:
    - Lab-based (using a camera to record the session)
    - Diary-studies (asking people to keep a diary of how they have used their mobile phone and any problems they encounter)
    - Paper prototypes (running usability testing on a paper-based version of the site, using mobile phone screen-sized pieces of paper)

You should choose the adequate usability method depending on the stage of the project and the target (users).

Set-top-Box usability testing

It is still hard to find based-on-the-experience methodologies on accessibility and usability in the context of interactive TV.

The applications for interactive television are based on web technologies to make it possible to use them with other browsing devices than the set-top-box. Full interoperability will not always be easy or even possible, but that's what we're aiming for.

The goal is to provide easy access to services and information to all people, not just those that have a computer with a broadband connection. That includes older people and people with disabilities. So basically we're talking about websites built with web standards and best practices for accessibility.

What makes these applications different is that they are displayed on a TV screen instead of a computer monitor, and you use a remote control to navigate them instead of a keyboard and a mouse.

Important differences compared to the web

Screen size: Television screens are often larger than computer screens, but the resolution is lower. And scrolling, though possible, is nowhere near as comfortable as in a web browser on a computer. So it is recommended to design the content around screenfulls.

The resolution of a Standard Definition PAL TV is 720 x 576 pixels (the NTSC system used in the US has a slightly different resolution). Then there's the title safe area you need to take into account. Yup, that removes another 20% of the available width and height. There is an area of 576 by 460 pixels which you can be confident that the user can see on their TV screen.

Safe areas on a PAL screen.
Red: Invisible area
Yellow: Action safe area
Green: Title safe area

Figure 46: Safe area. [WikipediaSafeArea]

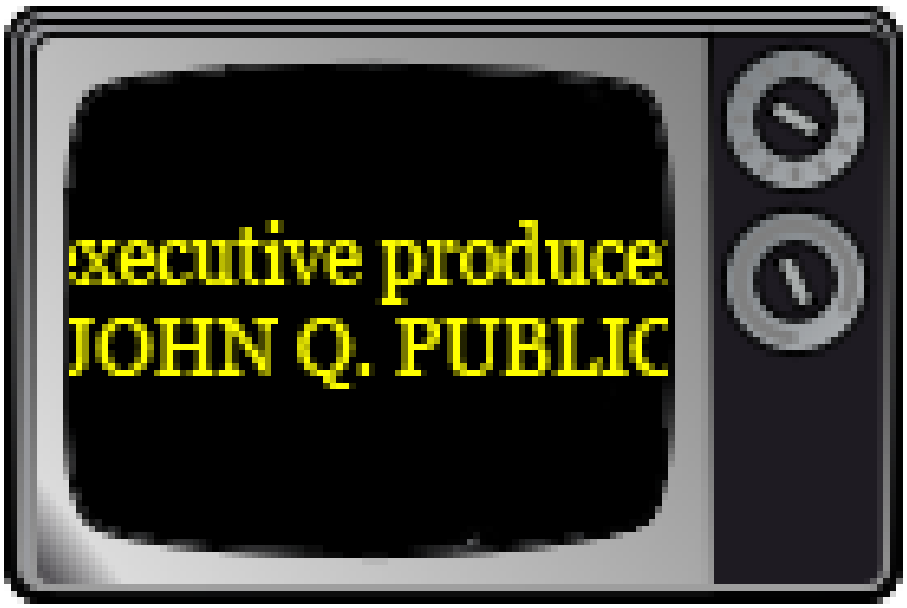


Figure 47: Importance of Safe area in old TV screens. [WikipediaSafeArea]

Rectangular pixels: TV pixels in standard definition are rectangular (wider than they are tall), not square like those on a computer screen. That means that circles will become ovals when they are viewed on the TV, and the designers should be aware of this[5]. This issue is even more noticeable in anamorphic signals.

Screen Aspect Ratio: Although the market is changing to widescreens, there are still a huge TV sets and channels using 4:3 PAL aspect ratio. Each TV has a different behaviour when displaying a different aspect ratio. The image could be letterboxed, pillar-boxed, cropped, stretched or compressed.

Interlacing: On a CRT television set each frame is made up of two interlaced fields. This makes thin horizontal lines vibrate or flicker. Plasma or LCD technologies convert the interlaced picture to progressive frames before displaying them. While the CRT televisions are still in use, you should verify statistics; it is recommended to use thicker or slightly blurred horizontal lines.

Colour and contrast: You are limited to a smaller range of colours on a traditional TV set. Fully saturated colours and some colour combinations tend to bleed. The picture is generally much fuzzier than that of a computer screen.

Viewing distance, fonts and readability: Because of the greater viewing distance you need to use larger text on TV than on a computer screen. And because of the interlacing issue, be careful with serif fonts. The best thing is to use a typeface that is specially designed for TV. If that is not an option, use a sans serif or slab serif font that is designed for on-screen reading. Try to increase line height a bit and add a little bit of letter spacing to avoid individual letters bleeding into each other. Make text and important graphics larger than a design for computer screen and even more when using a High Definition signal,

Navigation: The main navigation tool for ITV is the remote control. Other options like wireless keyboards and mice are available, but the remote control is the default. Make sure not do design fly-out menus and other stuff that relies on precise mouse control to use. 5-key navigation should be enough.

Sound: Websites rarely use sound; television uses sound a lot. Speech needs to be made available to people who can't hear. For the accessibility's sake, a designer can use captioning and can translate the speech to sign language. Sound that contains speech should be clear, with no distracting noises or background music. If that isn't acceptable, provide an option for the user to choose a "clear" sound channel with no distractions. [BRAINS].

More info can be found in [Johansson]

7.4.2 3D Devices

From the user perspective, displaying device is the most important part of end-to-end 3DTV system. The diversity of available equipment is very wide. Indeed, there is number of solutions (many at a prototype level), but in this deliverable we consider only these, which have a market potential.

Some classifications of 3D displays are presented in the literature. In general, we can divide presentation techniques into two groups in terms of different cues of special vision on which their design is based. The first phenomenon is stereoscopy, so displays are designed to channel the left- and right-eye views to the appropriate eye. In this category we can find stereoscopic displays which demand additional tools to use during a show, as well as auto-stereoscopic displays which do not need any extra support. The second phenomenon is motion parallax which is a basis for electro-holography and volumetric displays.

S. Pastoor in [Sch05] provided more detailed classification (Table 3). The main feature of distinction is eye-addressing method.

[5] The latest Photoshop versions have support for non-square pixels and even let the designer switch view modes between square and rectangular pixels.

Principle of eye addressing		Origin of waves	Number of views	Motion parallax
aided-viewing (stereoscopic)	colour multiplex,	Fixed image plane, gaze-controlled image plane	2	optional (for a single observer)
	polarization multiplex			
	time multiplex			
	location multiplex			
free viewing	direction multiplex (e.g., by diffraction, refraction, reflection, occlusion)	fixed image plane, gaze-controlled image plane	2	optional (for a small number of observers)
(auto-stereoscopic)	volumetric display, electro-holography	distinct depth planes (slices), entire space	∞	Inherent (for a small number of observers)

Table 3: Classification of 3D display techniques [Sch05]

Except location multiplex eye addressing, aided-viewing methods require special glasses which are constructed as filters or shutters. Providing left or right channel of view information from a single display or screen to proper eye of each viewer is the principle of working of these glasses. The difference is when using location multiplex methods – users have to wear glasses-like head mounted displays, so that view information is distributed to each eye by dedicated micro-display. This technique is not in area of our interest, because user is isolated from the real world when using such equipment.

Colour multiplex methods

Two methods are considered in this type of displaying 3D content: the wavelength-division multiplexing and the multiband filters. The difference between them is the amount of bands distinguished in the visible light spectrum.

The first type, so called anaglyph method is the simplest one. The visible light spectrum (370-730 [nm]) is divided into two bands for example 370-550 [nm] (blue colour) and 550-730 [nm] (red colour) [Hal07]. However, even if there are two significant advantages of using this technique, its disadvantages are very serious in terms of QoE. First advantage is that special screen or display is not required – well-known means are sufficient to present 3D content. The second – devices (glasses) are very cheap and easy to produce. Main disadvantage is very low comfort caused by insufficient colour reproducibility, colour rivalry and optical crosstalk (poor spectral separation of coloured lenses).

The second type is technique based on multi-band filters. This technique is improvement over the anaglyph method. The visible light spectrum is divided into two complementary sets of wavelength intervals [Hal07]. An improvement in colour reproduction is possible, if those sets are uniformly spread out across the light spectrum. Such filters are produced by Infitec GmbH (Germany) [Jor03]. The reason why this method is capable to support the perception of 3D images is that human eye cannot distinguish different compositions of the same colour. However in terms of QoE, there are such advantages as minimizing the optical crosstalk, better colour reproduction then it is with anaglyphs, no need to use non-depolarizing screens, there is also very strong disadvantage – a high cost of production precise multi-band filters.

Polarization multiplex methods

Two types of polarization multiplex methods can be distinguished. The first type exploits linear polarization effect – horizontal and vertical polarizers, whereas the second applies circular polarization effect – circularly polarized filters (clock-wise and counter clock-wise). The main difference is the source of opti-

cal crosstalk – linear polarization is sensitive to rotations such as viewers head motion while when it comes to circular polarization, the crosstalk is mostly shift-invariant.

Both polarization multiplex methods support full colour reproduction so they reduce visual discomfort typical for anaglyph systems. Unfortunately, polarization filters block a significant amount of light and that is why projectors with increased brightness are required. Additionally, non-depolarizing screen is necessary to present 3D content in this technique. When it comes to costs – circular polarizes are more expensive than the linear ones.

There are two types of projection systems. The first of these is the method of introducing two projectors. In this configuration it was crucial to maintain the alignment of two projected images, because misalignment is a major cause of eye strain [Hal07]. Two projectors were then replaced by a dynamic polarization modulator in front of a single projector, but this solution requires a projector capable of doubled refresh rate. Such implementations are provided by RealD Inc. (ZScreen®) and Vrex Inc. (µPol™), and difference between them is type of applied polarization.

RealD Inc. has developed solution which improves their dynamic polarization modulator. In the Figure 14 there is presented timing diagram which shows how the input signal is sped up and interleaved in the projector to produce sequential left and right eye views. When double flash interleaved there is 96 fps ratio and sequence is L1, P1, L1, P1, L2, P2, L2, P2… (L*x* – left image, P*x* – right image), whereas for triple flash interleaved there is 144 fps ratio and sequence is L1, P1, L1, P1, L1, P1, L2, P2, L2, P2, L2, P2… This enhancement exceeds the fusion threshold for much smoother motion and provides less phase difference between left and right eye views what directly increase visual comfort [Nab06].

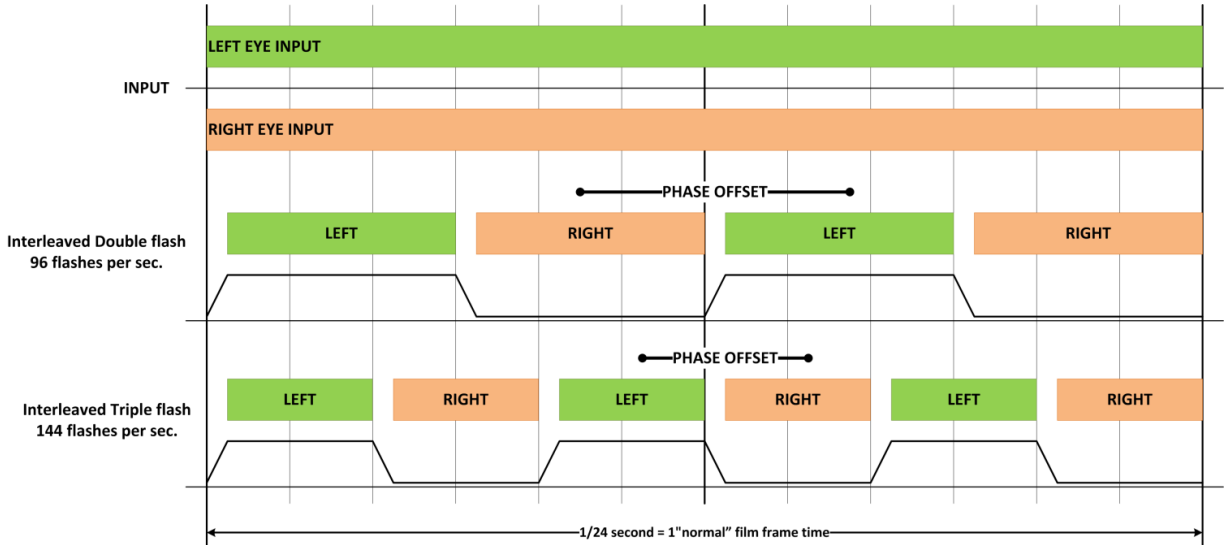


Figure 48: Timing diagram showing how the input signal is sped up and interleaved in the projector to produce sequential left and right eye views [Nab06]

Time multiplex method

The challenges such as image alignment and sufficient brightness of projectors can be resolved by employing time multiplex method. In this approach, polarization glasses are gave way to shuttered glasses with liquid-crystal shutters (LCS). The eye-addressing is supported by two states of each lens – opaque and transparent, which alternate with synchronism with the screen. This architecture requires high refresh rates of at least 120Hz. Main advantages of this shuttering systems is full spatial resolution and full colour gamut.

Depending on applied equipment there are several sources of the crosstalk. When combination of CRT display and LCS glasses is applied, the main factors are screen phosphor persistence, LCS extinction characteristics and LCS timing errors [Bos91]. In [Lip94] and [Kon00] there are presented signal processing algorithms to compensate for the crosstalk which are constructed on base of its shift-invariance nature and the fact that CRT phosphor persistence and LCS light extinction characteristics are quit uniform spatially.

Auto-stereoscopic displays

Auto-stereoscopic methods are designed to provide depth perception without using any additional devices such as glasses or helmets. The principle of working of auto-stereoscopic displays is to direct light emitted by pixels to proper eye. There are several optical phenomenon like diffraction, refraction, reflection and occlusion which are basis to construct auto-stereoscopic displays [Sch05]. In this deliverable we present only these of them which have market potential.

Designers have formulated two ideal assumptions for auto-stereoscopic techniques: each of observers eye should see different images (so that the stereoscopy is possible) and observer who is moving in front of a display should see images from the perspective which corresponds to the place of observation. It is obvious that fulfilling both of these assumptions simultaneously is extremely challenging task [Dod05].

In [Dod05] there is proposed taxonomy of auto-stereoscopic displays which is graphically presented in the Figure 49.

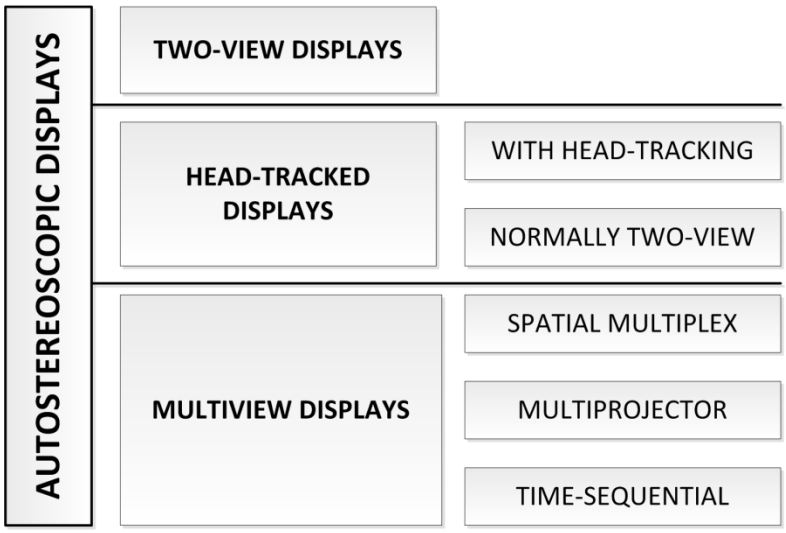


Figure 49: Taxonomy of auto-stereoscopic displays

For two-view displays, there have been invented two basic approaches to direct proper images to corresponding eyes: parallax barrier displays and lenticular displays. Both designs are thoroughly described in literature [Hol03], [Sch05], [Hal07], [Dod05]. The main disadvantage of these solutions is that there are proper positions of observer required to provide correct depth perception – not only horizontal position but also the distance from displays surface. When viewer's eyes straddle two different viewing zones, the presented left and right views are reversed. In this situation viewer sees a *pseudo-scopic* or *depth inverted* image [Hal07]. This is the source of visual confusion and discomfort for the viewer. There can be also observed special type of optical crosstalk – since one slit or lens can produce an image using its neighbour's data. It is also possible that contrast of images from adjacent pixels is reduced by lens aberrations. The next disadvantage is loss of horizontal resolution delivered to each eye.

However, in questioned drawbacks are partially resolved by introducing head-tracking, new issues comes up into consideration. The number of viewers which is limited to one, but when user is moving too fast picket fence effect may occur [Sch05]. These solutions are called active 3-D displays [Hal07].

The second assumption for auto-stereoscopic techniques is fulfilled by multi-view displays. Not only observer who is moving in front of a display can see images from the perspective which corresponds to his location, but also many observers can take part in presentation. As it is shown in figure 15 there are three main types of multi-view displays. Those with spatial multiplex extendcapabilities of well-known approaches – parallax barrier and lenticular displays. Indeed, in [Ber96] there is presented the design which uses both horizontal and vertical multiplexing to provide a 3D display with reasonable resolution in both dimensions.

Multi-projector systems are implemented in a way that every view has dedicated projector to present exact content. Such system was developed by Mitsubishi Electric Research Laboratories [Merl]. There

are several advantages of this application – full spatial resolution of each view and many viewing zones. The main disadvantage is high cost which grows proportionally for every next view [Mol05], [Tra90].

User-specific problems

There are some disabilities that make it impossible to perceive 3D effect when stereopsis is used to cause it. First, which is estimated to affect 5-10% of population is stereoblindness (inability to see 3D image). Second disability is strabismus (misalignment of the two eyes) which can be surgically corrected at an early age so stereoscopic vision may develop normally. Third, visual abilities change with age so older adults are less sensitive then younger adults to perceiving stereoscopic depth. People with such afflictions can watch content on each presented 3D display technology, but they will not experience an enhanced sense of depth during a show. In case of discomfort while viewing 3D content the user will have an option to switch to the 2D version of the same content.

8 Summary of user requirements

In order to clearly identify and categorise the user requirements in a way that is easily linked with the DoW of the project, the corresponding Figure 12 from the Description of Work document has been used. In this figure, the most important topics and roles of partners in the project are identified through use of the Wordle tool, and these can be identified as:

- P2P,
- Service provision and quality,
- Media streaming,
- Social networks,
- Networking/protocols,
- Scalable coding.

Figure 50: Major areas of the project as identified through word clouds

The conclusions reported so far from the requirements capturing process have been categorised according to the 6 areas identified in the above figure, while they have been translated to specific requirements, each identified through a unique identifier. The following table summarises the results of this task. As it is reported out of the 24 requirements identified:

- 9 of the requirements refer to P2P,
- 17 to Service provision and quality,
- 5 to Media streaming,
- 4 to Social networks,
- 2 to Networking and protocols,
- and 2 to Scalable coding[6].

The list of requirements was compiled using a balanced (50%-50%) percentage of answers from the end-users and the experts, with 17 requirements coming out of the processing of the end-users' questionnaire survey results, and 17 out of the processing of experts feedback (6 from the interviews and 11 from the feedback on focused questions referring to real world experience and the use of standards.

[6] Note that some of the requirements fall into more than one category.

Code	Area	Source of requirement	Conclusion from the requirements capturing process	Requirement
Req1	**P2P**	User questionnaire	Users have embraced the reciprocal model of resource sharing used in Bit Torrent, and therefore use of similar models in the distribution of media streams could be easily adopted	Use of successful models in P2P content and media streaming inspired by Bit Torrent should be adopted
Req2	**Service provision and quality**	User questionnaire	Laptop computer is the most popular device of the respondents as regards internet access, followed by the desktop computer and mobile device	Use cases should include primarily the use of laptop devices
Req3	**Service provision and quality**	User questionnaire	Users prefer devices with mobile internet support	Use cases over wireless environments should evolve around the use of mobile internet
Req4	**Media streaming**	User questionnaire	Use of the web as the platform over which media streaming should be provided in SARACEN is more promising than a closed environment similar to that of VoD services	User interface should be built using the web as a platform (including streaming services)
Req5	**Media streaming**	User questionnaire	Streaming services supporting HD should be among the priorities of the project, while mobile devices should be used mostly as «end sink» terminals	Support and demonstration of HD capabilities by the platform is important
Req6	**Social networks**	User questionnaire	As regards the social networking aspects of the platform, compatibility and experience from YouTube and Facebook should be used	Social networking aspects should be addressed having in mind the use of successful examples like Facebook and YouTube

Code	Area	Source of requirement	Conclusion from the requirements capturing process	Requirement
Req7	**Networking/protocol**	User questionnaire	Wi-Fi support should be given top priority as regards support for wireless and mobile technologies in the project.	Wi-Fi support by the platform is important and should be the use case for wireless /mobile access demonstrating scenarios
Req8	**Media streaming/ Service provision and quality**	User questionnaire	The SARACEN platform should be able to support all possible types of live content coverage	The SARACEN platform should be able to support all possible types of live content coverage
Req9	**P2P/Media streaming/Social networks**	User questionnaire	There is interest in the transmission of live content of sports or concerts over P2P architectures (with the participation of users in the media distribution network), while the majority prefers the participation through groups of the same interest as regards the content	Use of Social networking information for the formation of focused groups supporting P2P distribution should be foreseen
Req10	**Service provision and quality**	User questionnaire	Use of advertising as a means of avoiding or reducing customers cost for using the platform would be acceptable by the majority of users. Users seem willing to accept advertisements in order to reduce the cost for accessing personalised streaming services	Business models should take into account use of advertising as a means of avoiding or reducing customers cost
Req11	**Service provision and quality**	User questionnaire	Users would prefer a non-interrupted viewing experience, similar to that of coverage of a football match.	Streaming experience should not be interrupted (i.e. for advertisements)
Req12	**Media streaming**	User questionnaire	The platform should emphasise on real time streaming, with the ability of incorporating small videos with no need for enhanced PVR functionality	Emphasis should be given to Real time streaming rather than Access to pre-recorded videos

Code	Area	Source of requirement	Conclusion from the requirements capturing process	Requirement
Req13	**Service provision and quality**	User questionnaire	Revenue through subscriptions and payment of users should focus on the distribution of HD content, while alternative means (participation in the P2P distribution scheme through their nodes, accepting advertisement messages) should be considered	Business models should focus on HD content provision and novel schemes for payment/charging should be considered
Req14	**Social networks**	User questionnaire	Users in general seem willing to provide personal preference information and share content in order to participate and support the provision of a personalised media distribution service. Special care should be provided in order to ensure protection against viruses and malicious software downloads	Use of personal information for enhancing the media distribution process over P2P should be foreseen in the design of the platform
Req15	**Service provision and quality**	User questionnaire	SARACEN platform should consider the provision of advanced searching mechanisms. However, these should not be given top priority	Use of advanced searching mechanisms would be an add on feature, but should not be given top priority
Req16	**Scalable coding**	User questionnaire	The project should carefully select use cases that can clearly demonstrate the benefits of scalable coding and the enhanced adaptability functionality they provide for the platform	Use cases should focus on demonstrating the benefits of scalable coding in terms of adaptiveness
Req17	**Social networks/ Service provision and quality**	User questionnaire	Tagging capabilities should be offered as added value functionality but for free.	Tagging capabilities for the videos should be supported, without any requirement for linking to charging schemes

Code	Area	Source of requirement	Conclusion from the requirements capturing process	Requirement
Req18	**P2P/Service provision and quality**	Experts' interview	The majority of experts seem to be in favour of using a browser plug-in for P2P application module. However, as even in this case, installation will be required, the adoption of a download and install application is not excluded	P2P support should be provided preferably through a plug-in. If this is not possible, application download and install could be acceptable
Req19	**P2P**	Experts' interview	All experts agree that P2P network has to be based on a mature and well tested open source P2P platform	Support for P2P should be based on open source solutions. As en extension, use of open source should be adopted in general in the project
Req20	**Scalable coding**	Experts' interview	MDC is considered as more promising than SVC especially when used over P2P. However, SVC as an extension of the H.264/MPEG-4 AVC video compression standard is possible to achieve fine adaptation capability with only 10% overhead	Use of both MDC and SVC coding schemes should be pursued, with the first one more related to the P2P based scenarios and related use cases
Req21	**Networking/protocols**	Experts' interview	Use of TCP as a layer 4 solution is preferred by most of the experts, with UDP following due to its inherent link with the use of RTP. DCCP is acknowledged for its advantages but there is scepticism about integration with different OSes	Use cases and demos should be based on the use of TCP for ensuring wide deployment, while more research oriented scenarios should focus on the use of DCCP
Req22	**Service provision and quality**	Experts' interview	Use of HTML5 is preferred, though concerns about the maturity of the standard are raised by the experts	Use of HTML5 should be pursued, provided that it does not conflict with other requirements or objectives of the project

Code	Area	Source of requirement	Conclusion from the requirements capturing process	Requirement
Req23	**Service provision and quality**	Experts' interview	Use of C++ is preferred by the experts due to the fact that most of the decoders are written in this language while Javascript and Python could be easily combined with the use of HTML5 is it is adopted by the project	Programming platform selection is open, with preference to C++ or alternatively to Javascript/Python
Req24	**P2P**	Feedback from experts based on real word experience	Direct guideline from the experts	The system shall preserve user privacy and protect the communications between peers from eavesdroppers
Req25	**P2P**	Feedback from experts based on real word experience	Direct guideline from the experts	The system shall not preclude running of several P2P clients on the same Home Network (behind NAT)
Req26	**P2P**	Feedback from experts based on real word experience	Direct guideline from the experts	Users shall be able to create and distribute their own content as well as consume content from multiple providers
Req27	**P2P**	Feedback from experts based on real word experience	Direct guideline from the experts	It shall be possible to restrict access to user content or provider content even to authorised peers
Req28	**P2P**	Feedback from experts based on real word experience	Direct guideline from the experts	It shall be possible to restrict the ability to identify user content or provider content even to authorised peers
Req29	**Service provision and quality**	Feedback from experts based on real word experience	Broadcasting rights change from country to country and even within provinces of countries and can also be restricted to allowing a broadcaster rights to distribute that content for	Business models should take into account the special conditions that governing the broadcasting rights

Code	Area	Source of requirement	Conclusion from the requirements capturing process	Requirement
			a limited time	
Req30	**Service provision and quality**	Feedback from experts based on real word experience	Broadcasters **replicate** several of the copyright holders' exclusive privileges, and they have rights to authorise the reproduction of fixations, and consciously contemplate a multiplicity of lawsuits for a single act of infringement	Business models should ensure that the content is used properly under the authorization of broadcasters & the content provider
Req31	**Service provision and quality**	Feedback from experts based on real word experience	Broadcasters are losing huge amount of revenues due to piracy and unauthorised retransmission of broadcasts, the emergence of video over internet will extend the problem.	Business models should study & propose ways of preventing and avoiding unauthorised retransmission of content especially through internet
Req32	**Service provision and quality**	Feedback from experts based on real word experience	The broadcast chain (content producers, followed by broadcasters, then cable companies)are each interested in controlling the revenue streams associated with their contribution to the process	Business models should examine ways of managing &controlling the cost of the content used
Req33	**Service provision and quality**	Feedback from experts based on real word experience and standards	The system should be compliant with usability standard ISO 9241	SARACEN should follow the recommendations of ISO 9241
Req34	**Service provision and quality**	Feedback from experts based on real word experience and standards	The system should be compliant with accessibility standards (from the point of view of access for everybody)	SARACEN should follow the recommendations of ISO 9241-20 and ISO 9241-171. The website design, should follow WCAG2.0 directives

Code	Area	Source of requirement	Conclusion from the requirements capturing process	Requirement
Req35	3D	Feedback from experts and/or based on literature analysis	3D technology is an emerging novelty, that can be compared to the revolution caused by introduction of HD video	SARACEN should be aware of 3D technology, should implement 3D capabilities where possible
Req36	3D	Feedback from experts and/or based on literature analysis	3D technology can introduce doubled network bandwidth demands	SARACEN should be aware of doubled networking requirements, unless 3D-specific coding techniques, such as multiview coding, are used
Req37	3D	Feedback from experts and/or based on literature analysis	3D video encoding and streaming can introduce new kinds visual artifacts, previously unknown for 2D	SARACEN should apply 3D QoE models in order to maintain usable video quality
Req38	3D	Feedback from experts and/or based on literature analysis	Almost 2 out of 3 users believe in mobile 3D technology	SARACEN should try to cover mobile devices such as the early 3D adopters from the mobile devices generation like LG Swift 3D / LG Optimus 3D

Table 4: List of requirements

The above table fully covers the platform needs. It is going to be used as the basis for the architecture, together with the corresponding investigation of needs from the networking point of view.

As a final note, it should be mentioned that some issues that relate to the deployment of services and are more related with the use of devices and platforms (such as programming tools and use of standards) have been included in the service provisions and quality category. These issues are expected to be addressed more thoroughly in the specifications task, based on the preliminary input reported in this document mainly from the experts' interviews.

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10 ANNEXES

10.1 Annex A: List of known CDNs

Non Pure-Play CDNs
AT&T
Broadmedia
BT (will launch by year's end)
Deutsche Telekom (partnered with EdgeCast)
Global Crossing (reselling Limelight and EdgeCast)
Internap (acquired VitalStream)
Level 3 (acquired CDN assets of SAVVIS, acquired Servecast)
NaviSite (reselling EdgeCast)
NTT Communications
Pacnet (partnered with Internap)
PCCW
Reliance Globalcom (partnered with Internap)
Tata Communications (partnered and invested in BitGravity)
TeliaSonera (will launch in April)
Pure-Play CDNs
Accelia
Abacast
Advection.net
Akamai
Amazon Web Services
BitGravity
BitTorrent
CacheFly
ChinaCache
CDNetworks
Cotendo
Conviva
Digital Fountain (acquired by Qualcomm 2/09)
EdgeCast
EdgeStream
Grid Networks (merged with GMS 4/09)
Highwinds
Itiva

Limelight Networks

Mirror Image

Move Networks

Pando Networks

Panther Express (acquired by CDNetworks 2/09)

PEER1

Real Broadcast Network

Technicolor

Velocix

Voxel.net

Vusion

10.2 Annex B: List of Major International Broadcasters

The EBU (European Broadcasting Union) has 75 active members, from 56 countries in and around Europe, and 43 associate members around the world.

http://www.ebu.ch/en/ebu_members/actives/index.php

http://en.wikipedia.org/wiki/EBU

The ITU (International Telecommunication Union) is an agency of the United Nations which regulates information and communication technology issues, and the global focal point for governments and the private sector in developing networks and services.

http://www.itu.int/

http://en.wikipedia.org/wiki/ITU

List of international television broadcasters:

http://en.wikipedia.org/wiki/List_of_international_television_channels

List of international radio broadcasters:

http://en.wikipedia.org/wiki/International_radio_broadcasters

10.3 Annex C: Questionnaire sample

10.3.1 Annex Ca: Questionnaire sample in English

Create SARACEN: End-User Questionnaire

Demographics / Identification

1) Gender *:
Please indicate your gender?

- ○ Male
- ○ Female

2) Age *:
Please indicate your age

[▼]

3) Location *:
What is your current country of residence?

[United Kingdom ▼]

4) *:
How did you find out about this survey?

[▼]

Technology/Internet experience/Usage

5) Please specify how familiar you are with the following.
Familiarity with internet *:
How would you characterize your experience level related to the use of internet?

- ○ Unfamiliar
- ○ Novice
- ○ Medium
- ○ Very good
- ○ Expert

Familiarity to technology *:
How would you characterize your experience level related to the use of Information and Communication Technology?

- ○ Unfamiliar
- ○ Novice
- ○ Medium
- ○ Very good
- ○ Expert

Familiarity with social networking applications *:
How would you characterize your experience level related to the use of social networking applications (i.e. facebook, twitter)?

- ◉ Unfamiliar
- ○ Novice
- ○ Medium
- ○ Very good
- ○ Expert

6) Social Networks :
Which of the following Social Networks do you use? (check all that apply)

- [ ] Facebook
- [ ] MySpace
- [ ] YouTube
- [ ] Vox
- [ ] Bebo
- [ ] Twitter
- [ ] Linkedin
- [ ] Blogspot
- [ ] Flickr
- [ ] Friendster
- [ ] Google Buzz
- [ ] NONE

Other :
Other (please state)

7) *:
How often do you use a social networking application?

- ○ Very often
- ○ Often
- ○ Sometimes
- ○ Rarely
- ○ Never

8) *:
Are you aware of P2P (Peer 2 Peer) applications?

- ○ Yes
- ○ No
- ○ I do not know

9) :
If yes, please indicate which of the following P2P clients you currently use (check all that apply)

- [ ] BitTorrent
- [ ] Ares
- [ ] Kazaa
- [ ] Limewire
- [ ] eMule
- [ ] DC++

Other :
Other (please state)

10) Type of devices/equipment used (for internet access)

Which of the following devices do you use for internet access? What type of equipment do you use on a daily basis? (check all that apply)
Laptop computer

- ☐ Access Internet
- ☐ Use Daily

Desktop computer

- ☐ Access Internet
- ☐ Use Daily

Mobile device

- ☐ Access Internet
- ☐ Use Daily

Set top box/console

- ☐ Access Internet
- ☐ Use Daily

Mobile Features :
If yes, what services does it support? (check all that apply)

- ☐ Video streaming
- ☐ Mobile internet
- ☐ VOIP

Set top box :
If yes, what services does it support?

- ☐ VOD
- ☐ Internet services

11) Type of internet connection at home *:
What type of internet connection do you use home?

- ○ Non high speed (Dial-up, ISDN)
- ○ Wired Broadband <= 4Mbps
- ○ Wired Broadband > 4Mbps
- ○ Wireless Broadband <= 1Mbps
- ○ Wireless Broadband > 1Mbps
- ○ 3G services

12) :
What type of wireless network technologies do you use to access online content? (check all that apply)

- ☐ GSM
- ☐ 3G
- ☐ WiFi
- ☐ DVB

Viewing habits

13) Importance of real time support for the following content :
Which of the following content would you like to watch live? (check all that apply)

- ☐ Athletic events / sports
- ☐ Concerts
- ☐ News
- ☐ TV shows

Language [Language neutral ▾]

14) Please indicate which of the following services you are likely to use

Share my own generated content, such as videos and photos, through my social networks *

- ○ Very likely
- ○ Somewhat likely
- ○ Neutral
- ○ Somewhat unlikely
- ○ Very unlikely

Share my personal videos (over P2P networks). *

- ○ Very likely
- ○ Somewhat likely
- ○ Neutral
- ○ Somewhat unlikely
- ○ Very unlikely

Share my videos from all my Social networks through one application. *

- ○ Very likely
- ○ Somewhat likely
- ○ Neutral
- ○ Somewhat unlikely
- ○ Very unlikely

View videos which are shared by my friends. *

- ○ Very likely
- ○ Somewhat likely
- ○ Neutral
- ○ Somewhat unlikely
- ○ Very unlikely

Watch a live concert or a football match over P2P live streaming. *

- Very likely
- Somewhat likely
- Neutral
- Somewhat unlikely
- Very unlikely

Create groups with other users having the same interests as you regarding videos, photos etc. *

- Very likely
- Somewhat likely
- Neutral
- Somewhat unlikely
- Very unlikely

Get informed if a user in your group uploads a new video *

- Very likely
- Somewhat likely
- Neutral
- Somewhat unlikely
- Very unlikely

Watch VOD in HD format *

- Very likely
- Somewhat likely
- Neutral
- Somewhat unlikely
- Very unlikely

Media-quality-price

15) *:
Would you be willing to use a service that allows you to have personalised content (e.g. video recommendations, share your own generated HD content) for free if it contained marketing material e.g. video advertisements?

- Yes
- No

16) *:
Would you be willing to view advertising material in order to cover all or part of the cost of this service?

- Yes
- No

16b) :
If YES, when would you prefer to view the advertisement?

- (•) N/A
- ( ) before the content to be visualized
- ( ) superimposed on the content as it is being visualized

17) *:
How often do you use Video on Demand services?

- ( ) Very often
- ( ) Often
- ( ) Sometimes
- ( ) Rarely
- ( ) Never

18) Please indicate your willingness for the following

Willingness to pay for ability to broadcast content *:
I am willing to pay for an added value service that allows me to broadcast my own generated video content.

- ( ) Very likely
- ( ) Somewhat likely
- ( ) Neutral
- ( ) Somewhat unlikely
- ( ) Very unlikely

Willingness to pay for interactive viewing (insert comments, text to the streamed content) *:
I am willing to pay for an added value service that allows me to contribute my own content (text, pictures) during a transmission.

- ( ) Very likely
- ( ) Somewhat likely
- ( ) Neutral
- ( ) Somewhat unlikely
- ( ) Very unlikely

I am willing to contribute in alternative ways instead of money *:
(e.g. offer the use of my own equipment as part of the distribution chain even when I'm not viewing)

- ( ) Very likely
- ( ) Somewhat likely
- ( ) Neutral
- ( ) Somewhat unlikely
- ( ) Very unlikely

I am willing to pay an extra amount of money for viewing HD Videos on Demand *

- Very likely
- Somewhat likely
- Neutral
- Somewhat unlikely
- Very unlikely

19) Please indicate how much you agree or disagree with the following statements

Willingness to provide personal preferences information *:
I am willing to provide personal preferences information to my service provider in order to improve your viewing experience through personalization.

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Willingness to provide my profile information *:
I am willing to provide my profile information for the formation of user groups in order to improve personalization

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Willingness to install a new application *:
I am willing to install a new application on my personal device in order to have access to a P2P media streaming service.

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Awareness of the personal data protection framework *:
I am aware of the personal data protection framework

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Willingness to share content *:
Willingness to share content with other users.

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Willingness to enable other users to download content that belongs to me *:
Willingness to enable other users to download content that belongs to me

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Willingness to download content *:
Willingness to download content, despite of the possibility of downloading malicious software (viruses, Trojan horses etc)

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

20) Please indicate how much you are interested in the following services

Willingness to share your saved searches *:
How interested would you be in sharing your saved searches and content filters with your friends and family and the general public?

- Very interested
- Somewhat interested
- Neutral
- Somewhat uninterested
- Very uninterested

Interest in seeing and collecting saved searches *:
How interested would you be in seeing and collecting the saved searches and content filters that have been made by other people who share your interests?

- Very interested
- Somewhat interested
- Neutral
- Somewhat uninterested
- Very uninterested

Interest in setting up persistent searches *:
How interested would you be in setting up persistent searches, and receiving spontaneous alerts that there was something interesting to see?

- Very interested
- Somewhat interested
- Neutral
- Somewhat uninterested
- Very uninterested

Scalable Video Coding

Please make sure your sound is turned on

The following video explains the difference between a usual video and a SVC (Scalable Video Coding) video. Please watch the video and answer the following questions.

21) Please indicate how much you agree or disagree with the following statements

Video Quality *:
I could clearly see the difference in quality of the 2 streams in the video

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Video Clarity *:
The video helped me to understand the benefits of Scalable Video Technology.

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Willingness to pay for video *:
I would pay for a technology that enables me to watch recorded videos in any format (SD or HD)

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Tagging video

Please make sure your sound is turned on.

The following video explains how tagging and metadata can be used to make your media more content rich. Please watch the video and answer the following questions.

22) Please indicate how much you agree or disagree with the following statements

The video helped me to understand the benefits of video media tagging. *

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

Video media tagging would be of great benefit to me *

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

I would pay for a technology that enables me to watch recorded videos in any format (SD or HD) *

- Strongly Disagree
- Tend to disagree
- Undecided
- Tend to agree
- Strongly Agree

On behalf of the SARACEN consortium, we would like to thank you for completing the survey.

10.3.2 Annex Cb: Questionnaire sample in Greek

Ερωτηματολόγιο Χρήστη
Δημογραφικά

1) Φύλο *:
Παρακαλώ υποδείξετε το φύλο σας

- Άρρεν
- Θήλυ

2) Ηλικία *:
Παρακαλώ υποδείξετε την ηλικία σας

3) Τόπος Διαμονής *:
Ποιά είναι η χώρα διαμονής σας;

Ηνωμένο Βασίλειο

4) *:
Πώς μάθατε για τη συγκεκριμένη έρευνα;

Τεχνολογική/Διαδικτυακή Εμπειρία/Χρήση

5) Παρακαλώ υποδείξετε το επίπεδο εξοικείωσης σας με το διαδίκτυο χρησιμοποιώντας την παρακάτω κλίμακα

Εξοικείωση με Διαδίκτυο

- Καθόλου εξοικειωμένος
- Αρχάριος
- Μέτριος
- Πολύ καλός
- Ειδήμονας

Πώς θα χαρακτηρίζατε το επίπεδο εξοικείωσης σας με τη χρήση Τεχνολογιών Πληροφορικής

- Καθόλου εξοικειωμένος
- Αρχάριος
- Μέτριος
- Πολύ καλός
- Ειδήμονας

Πώς θα χαρακτηρίζατε το επίπεδο εξοικείωσης σας με τη χρήση ηλεκτρονικών εφαρμογών κοινωνικής δικτύωσης (π.χ. facebook, twitter);

- Καθόλου εξοικειωμένος
- Αρχάριος
- Μέτριος
- Πολύ καλός
- (•) Ειδήμονας

6) Κοινωνικά Δίκτυα
Ποιές από τις ακόλουθες ηλεκτρονικές εφαρμογές κοινωνικής δικτύωσης χρησιμοποιείτε ;

- [ ] Facebook
- [ ] MySpace
- [ ] YouTube
- [ ] Vox
- [ ] Bebo
- [ ] Twitter
- [ ] Linkedin
- [ ] Blogspot
- [ ] Flickr
- [ ] Friendster
- [ ] Google Buzz
- [ ] KAMIA

Other :
Άλλη, δηλώστε:

7) * Πόσο συχνά χρησιμοποιείτε ηλεκτρονικές εφαρμογές κοινωνικής δικτύωσης;

- ( ) Πολύ συχνά
- ( ) Συχνά
- ( ) Ορισμένες φορές
- ( ) Σπάνια
- ( ) Καθόλου

8) * Γνωρίζετε τις εφαρμογές ανταλλαγής αρχείων μεταξύ χρηστών P2P (Peer 2 Peer);

- ( ) Ναι
- ( ) Όχι
- ( ) Δεν γνωρίζω

9) Εάν ναι, παρακαλώ υποδείξετε ποιες από τις ακόλουθες P2P χρησιμοποιείτε

- [ ] BitTorrent
- [ ] Ares
- [ ] Kazaa
- [ ] Limewire
- [ ] eMule
- [ ] DC++

Other :
Άλλη, δηλώστε:

10) Ποιες από τις ακόλουθες συσκευές χρησιμοποιείτε για πρόσβαση στο διαδίκτυο;

Φορητός Ηλεκτρονικός Υπολογιστής

- ☐ Διαδικτυακή Πρόσβαση
- ☐ Καθημερινή χρήση

Επιτραπέζιος Ηλεκτρονικός Υπολογιστής

- ☐ Access Internet
- ☐ Use Daily

Κινητή Συσκευή

- ☐ Διαδικτυακή Πρόσβαση
- ☐ Καθημερινή χρήση

Set top box/κονσόλα

- ☐ Διαδικτυακή Πρόσβαση
- ☐ Καθημερινή χρήση

Mobile Χαρακτηριστικά

Εάν χρησιμοποιείτε κινητό τηλέφωνο, ποιες από τις παρακάτω υπηρεσίες υποστηρίζει;

- ☐ Ροή βίντεο (streaming)
- ☐ Διαδίκτυο
- ☐ Φωνή μέσω IP (VoIP)

Set top box

Εάν χρησιμοποιείτε Set top box/κονσόλα ποιες από τις παρακάτω υπηρεσίες υποστηρίζει;

- ☐ VoD (Βίντεο κατ'απαίτηση)
- ☐ Υπηρεσίες Διαδικτύου

11) Είδος διαδικτυακής σύνδεσης στο σπίτι *

Τι είδους σύνδεση με το διαδίκτυο χρησιμοποιείτε στο σπίτι;

- ○ Παραδοσιακή/ Μη Ταχεία Σύνδεση (Dial-up, ISDN)
- ○ Ασύρματη ευρυζωνική σύνδεση <= 4Mbps
- ○ Ενσύρματο δίκτυο ευρυζωνική σύνδεση > 4Mbps
- ○ Ασύρματη ευρυζωνική σύνδεση <= 1Mbps
- ○ Ασύρματη ευρυζωνική σύνδεση > 1Mbps
- ○ Υπηρεσίες 3G

12) :

Τι είδους υπηρεσίες ασύρματου δικτύου χρησιμοποιείτε για πρόσβαση διαδικτυακού περιεχομένου;

- ☐ GSM
- ☐ 3G
- ☐ WiFi
- ☐ DVB

Προτιμήσεις Θέασης

13) Ποιες από τις ακόλουθες κατηγορίες περιεχομένου θα θέλατε να παρακολουθείτε ζωντανά;

- ☐ Αθλητικές εκδηλώσεις / Αθλητικά
- ☐ Συναυλίες
- ☐ Ειδήσεις
- ☐ Τηλεοπτικά Προγράμματα

Language [Ουδέτερα γλώσσας ▾]

14) Παρακαλώ υποδείξετε ποιες από τις ακόλουθες υπηρεσίες πιθανώς να χρησιμοποιούσατε

Κοινή προβολή περιεχομένου δικής μου δημιουργίας, όπως φωτογραφίες και βίντεο,μέσω ηλεκτρονικών κοινωνικών δικτύων *

- ○ Πολύ πιθανό
- ○ Κάπως πιθανό
- ○ Ουδέτερο
- ○ Κάπως απίθανο
- ○ Πολύ απίθανο

Κοινή προβολή προσωπικών βίντεο (μέσω δικτύων P2P) *

- ○ Πολύ πιθανό
- ○ Κάπως πιθανό
- ○ Ουδέτερο
- ○ Κάπως απίθανο
- ○ Πολύ απίθανο

Κοινή προβολή όλων των δικών μου βίντεο από τα ηλεκτρονικά κοινωνικά δίκτυα στα οποία συμμετέχω, μέσω μιας εφαρμογής *

- ○ Πολύ πιθανό
- ○ Κάπως πιθανό
- ○ Ουδέτερο
- ○ Κάπως απίθανο
- ○ Πολύ απίθανο

Παρακολούθηση βίντεο φίλων σε κοινή προβολή *

- ○ Πολύ πιθανό
- ○ Κάπως πιθανό
- ○ Ουδέτερο
- ○ Κάπως απίθανο
- ○ Πολύ απίθανο

Παρακολούθηση ζωντανής συναυλίας ή αγώνα ποδοσφαίρου μέσω ζωντανής ροής P2P. *

- Πολύ πιθανό
- Κάπως πιθανό
- Ουδέτερο
- Κάπως απίθανο
- Πολύ απίθανο

Δημιουργία ομάδων με άλλους χρήστες που έχουν τα ίδια ενδιαφέροντα με σας σχετικά με βίντεο, φωτογραφίες κλπ. *

- Πολύ πιθανό
- Κάπως πιθανό
- Ουδέτερο
- Κάπως απίθανο
- Πολύ απίθανο

Ενημέρωση για το αν ένας χρήστης στην ομάδα σας φορτώνει ένα νέο βίντεο *

- Πολύ πιθανό
- Κάπως πιθανό
- Ουδέτερο
- Κάπως απίθανο
- Πολύ απίθανο

Παρακολούθηση VoD σε μορφή υψηλής ανάλυσης (HD format) *

- Πολύ πιθανό
- Κάπως πιθανό
- Ουδέτερο
- Κάπως απίθανο
- Πολύ απίθανο

Μέσα-ποιότητα-τιμή

15) *:
Θα ήσασταν διατεθειμένοι να χρησιμοποιήσετε μια υπηρεσία που θα σας επέτρεπε να έχετε εξατομικευμένο περιεχόμενο (π.χ. βίντεο συστάσεις, προβολή περιεχομένου HD δικής σας δημιουργίας) δωρεάν εάν περιείχε διαφημιστικό υλικό;

- Ναι
- Όχι

16) *:
Θα δεχόσασταν να παρακολουθείτε την προβολή διαφημιστικού υλικού για την κάλυψη μέρος ή και όλων των εξόδων της παραπάνω υπηρεσίας;

- Ναι
- Όχι

16b) :
Εάν απαντήσατε ναι, πότε θα προτιμούσατε να παρακολουθείτε τη διαφήμιση;

- (•) Δεν έχω ιδιαίτερη προτίμηση
- ( ) Πριν το περιεχόμενο που θέλω να προβληθεί
- ( ) Κατά τη διάρκεια του περιεχόμενου που θα παρακολουθώ

17) *:
Πόσο συχνά χρησιμοποιείτε υπηρεσίες Video on demand(Βίντεο κατ'απαίτηση);

- ( ) Πολύ συχνά
- ( ) Συχνά
- ( ) Ορισμένες φορές
- ( ) Σπάνια
- ( ) Καθόλου

18) Παρακαλώ υποδείξετε την προθυμία σας ως προς τα ακόλουθα

Είμαι διατεθειμένος να πληρώσω για υπηρεσία επιπρόσθετης αξίας που θα μου επιτρέπει να συνεισφέρω δικό μου περιεχόμενο (κείμενο, εικόνες) κατά τη διάρκεια της ροής περιεχομένου

- ( ) Πολύ πιθανό
- ( ) Κάπως πιθανό
- ( ) Ουδέτερο
- ( ) Κάπως απίθανο
- ( ) Πολύ απίθανο

Είμαι διατεθειμένος να πληρώσω για υπηρεσία επιπρόσθετης αξίας που θα μου επιτρέπει να συνεισφέρω δικόμου περιεχόμενο (κείμενο, εικόνες) κατά τη διάρκεια της ροής

- ( ) Πολύ πιθανό
- ( ) Κάπως πιθανό
- ( ) Ουδέτερο
- ( ) Κάπως απίθανο
- ( ) Πολύ απίθανο

Είμαι πρόθυμος να προσφέρω με εναλλακτικούς τρόπους εκτός από χρήματα *:
(π.χ. προσφορά χρήσης του δικού μου εξοπλισμού ως μέρος της αλυσίδας διανομής ακόμη και όταν δεν συμμετάσχω)

- ( ) Πολύ πιθανό
- ( ) Κάπως πιθανό
- ( ) Ουδέτερο
- ( ) Κάπως απίθανο
- ( ) Πολύ απίθανο

Είμαι Πρόθυμος να πληρώσω επιπρόσθετο ποσό για τη προβολή HD Videos on Demand *

- Πολύ πιθανό
- Κάπως πιθανό
- Ουδέτερο
- Κάπως απίθανο
- Πολύ απίθανο

19) Παρακαλώ υποδείξτε πόσο συμφωνείτε ή διαφωνείτε με τις ακόλουθες δηλώσεις.

Είμαι διατεθειμένος να δώσω πληροφορίες για τις προσωπικές μου προτιμήσεις στην εταιρία παροχής της υπηρεσίας για την βελτίωση της υπηρεσίας μέσω περισσότερης εξατομίκευσης

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

Είμαι διατεθειμένος να δώσω τις πληροφορίες του προφίλ μου για τη δημιουργία ομάδων χρηστών ούτως ώστε να βελτιωθεί η εξατομίκευση υπηρεσιών

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

Είμαι διατεθειμένος να εγκαταστήσω καινούργια εφαρμογή στην προσωπική μου συσκευή για να έχω πρόσβαση σε υπηρεσία μέσων ροής P2P

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

Γνωρίζω ότι υπάρχει ένα πλαίσιο που προστατεύει τα προσωπικά μου δεδομένα

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

Είμαι διατεθειμένος να μοιραστώ περιεχόμενο με άλλους χρήστες

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

Είμαι διατεθειμένος να επιτρέψω σε άλλους χρήστες να λάβουν περιεχόμενο που μου ανήκει

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

Είμαι διατεθειμένος να λάβω περιεχόμενο, έστω και εάν υπάρχει κίνδυνος λήψης κακόβουλων λογισμικών (ιούς, Trojan horses κτλ.)

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

20) Παρακαλώ υποδείξετε πόσο θα σας ενδιέφεραν οι ακόλουθες υπηρεσίες

Θα σας ενδιέφερε να μοιράζεστε τα αποθηκευμένα αποτελέσματα μιας αναζήτησης και τα φίλτρα περιεχομένου (content filters) με φίλους, συγγενείς και το ευρύ κοινό;

- Δεν ενδιαφέρομαι
- Ενδιαφέρομαι λίγο
- Ουδέτερο
- Ενδιαφέρομαι
- Ενδιαφέρομαι πολύ

Θα σας ενδιέφερε να βλέπετε και να συλλέγετε τα αποθηκευμένα αποτελέσματα αναζήτησης και φίλτρα περιεχομένου (content filters) που δημιουργήθηκαν από άλλους χρήστες με κοινά ενδιαφέροντα μαζί σας;

- Δεν ενδιαφέρομαι
- Ενδιαφέρομαι λίγο
- Ουδέτερο
- Ενδιαφέρομαι
- Ενδιαφέρομαι πολύ

Θα σας ενδιέφερε η δημιουργία μόνιμων αναζητήσεων (persistent searches) και η παραλαβή ειδοποιήσεων (alerts) όταν υπάρχει κάτι ενδιαφέρον;

- Δεν ενδιαφέρομαι
- Ενδιαφέρομαι λίγο
- Ουδέτερο
- Ενδιαφέρομαι
- Ενδιαφέρομαι πολύ

Κλιμακωτή Κωδικοποίηση Βίντεο

Παρακαλώ βεβαιωθείτε πως έχετε ενεργοποιήσει τον Ήχο

Το ακόλουθο βίντεο εξηγεί την διαφορά μεταξύ ενός κανονικού βίντεο και ενός κωδικοποιημένου με Scalable Video Coding-SVC (Κλιμακωτή Κωδικοποίηση Βίντεο). Παρακαλώ παρακολουθήστε το βίντεο και απαντήστε τις ερωτήσεις.

21) Παρακαλώ υποδείξτε πόσο συμφωνείτε ή διαφωνείτε με τις ακόλουθες δηλώσεις.

Μπορούσα να διακρίνω με ευκολία τη διαφορά της ποιότητας μεταξύ των 2 ροών στο βίντεο

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

Το Βίντεο με βοήθησε να κατανοήσω το όφελος της Τεχνολογίας Κλιμακούμενης Κωδικοποίησης Βίντεο (Scalable Video Coding)

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

Θα πλήρωνα για μια τεχνολογία που θα μου επέτρεπε να προσθέτω μεταδεδομένα (metadata) σε SD ή HD βίντεο που ανήκουν σε εμένα ή σε άλλους

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

Βίντεο με Προσθήκη Χαρακτηρισμού (Tagging)

Παρακαλώ βεβαιωθείτε πως έχετε ενεργοποιήσει τον Ήχο

Το ακόλουθο βίντεο εξηγεί τους τρόπους με τους οποίους ο χαρακτηρισμός (tagging) και τα μεταδεδομένα (metadata) μπορούν να χρησιμοποιηθούν για την αναβάθμιση του περιεχομένου των μέσων σας. Παρακαλώ παρακολουθήστε το βίντεο και απαντήστε τις ερωτήσεις.

22) Παρακαλώ υποδείξτε πόσο συμφωνείτε ή διαφωνείτε με τις ακόλουθες δηλώσεις.

Το Βίντεο με βοήθησε να κατανοήσω το όφελος του Media Tagging *

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

Η χρήση του χαρακτηρισμού του video (Video media tagging) θα με βοηθούσε *

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

Θα πλήρωνα για μια τεχνολογία που θα μου επέτρεπε να προσθέτω μεταδεδομένα (metadata) σε SD ή HD βίντεο που ανήκουν σε εμένα ή σε άλλους *

- Διαφωνώ κάθετα
- Τείνω να διαφωνώ
- Αναποφάσιστος
- Τείνω να συμφωνώ
- Συμφωνώ απόλυτα

Εκ μέρους της κοινοπραξίας του έργου SARACEN θα θέλαμε να σας ευχαριστήσουμε που συμπληρώσατε το ερωτηματολόγιο.

10.4 ANNEX D Invitation

PrimeTel invites you to participate in the SARACEN survey

Would you find it useful to be able to stream High Definition using computers or handheld devices like your mobile phone? Together with several companies and universities from across the EU, PrimeTel has undertaken a project to research and create a state-of-the-art, online video streaming platform for High Definition media called SARACEN.

We have prepared a questionnaire asking you us to help we discover what you would really want to see from a system like this. This will take to you 10 minutes of your time and you will be helping in the system's requirements gathering.

You can answer the questionnaire here and find more information about the project by visiting the SARACEN website.

We would like to thank you in advance for your time.

Best Regards,

Research & Development Department

PRIMETEL