Conference Paper: on how storage at home will change how we watch television

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Abstract:

The availability of cheap mass storage will in the future make it possible to watch television programs at the moment we want it. To achieve this the storage of the required programs should be automated. Also we should find a way to make the retrieval of desired programs or scenes easier. Moreover it will also be possible to watch programs in a non-linear fashion as well as faster than real time. To make the system work the total content provision chain should be adapted to provide a typology of the broadcasted programs.

1 Introduction

The availability of low cost mass storage for home usage will bring a significant change in how people will watch television in the future. This will be mainly driven by the convenience users will experience when using storage. In a first chapter we will describe the many inconveniences users have at this moment and explore how they may be solved. In order to realize this we need however assistance from the broadcaster or service provider, such as a cable company. Whereas before content providers resisted the usage of storage at home because of copy issues, there is now a trend that the content providers will support it. The main reason for this is that the consumer is offered a lot of content in parallel and that he has a lot of choice. Content providers prefer that the end users watch (and pay) for their content and not of someone else. One approach is to make sure that their content is on your local discs. Then the chance that you will watch it increases significantly. Therefore many content providers are now willing to support to storage function at home. Later we will explain what is needed for this. In the second chapter we will examine what are the future technical possibilities. In a last chapter we will explore which technical challenges lie ahead of us.

2 The consumers wish:

The consumer when asked what he wants in the future usually can not answer this easily especially when it deals with apparatus in his home. He is already overwhelmed with al kinds of electronic appliances. But as the mobile phone brought a drastic change in how telephones are used, storage at home may cause a similar turnaround. It is expected that, when consumers experience the ease of use when having abundant local storage, they may seldom watch live TV. In this chapter we will review how a user may watch television in the future.

One of the problems is that interesting programs are broadcasted usually during specific time periods. Documentaries most often are not broadcasted during prime time and children programs not during the late hours of the day. More often it happens many times that on one day there are several interesting programs to watch (but they are unfortunately broadcasted at the same time on different channels) and on the next day there is nothing really interesting . It is clear that when programs are stored locally this problem disappears.

Another improvement that can be made is that the user can watch a program in a shorter time. If we take football as an example: a total match takes around two hours including the break. When it is stored, this time can be shortened significantly by skipping non-interesting parts of the game. Also it is possible to shorten the viewing time without the viewer even noticing it.

A last improvement will be the management of the stored content. It is known that consumers have currently a lot

of problems with first of all programming the VCR, then finding the right tape to store the program to be recorded and after it has been recorded to find the right tape when he wants to play back the program. This will also be solved in the coming years and we will elaborate on this in the next chapters.

The technical possibilities:

The main technology that will help this trend is the disc storage technology. For both hard disks as well as optical discs storage capacity will increase to a level that the above scenarios become possible. And we will need a lot of storage capacity. In our view we should make a distinction between temporary and long-term storage. We will analyze the requirements for both and also see if those requirements can be met.

For the temporary storage we have to investigate more deeply on how the total system will behave. A central component in the system is the consumer. We should start with the viewing time an average person would spend with watching TV per day. Although this number differs per country and age group we will assume an average of 3 hours per day per person in the home. With an average of two people per home who may watch different programs we arrive at six hours. Then there is the issue of how do we select the programs that should be stored on the disc. Especially for short-term storage this process should be automated to a large extent. It is inconceivable that this system will work if the consumer must program the disc system for each program it should store as he must do now with VCR's. However when the recording happens automatically it will always be that the system records also non-interesting programs. To take this into account we take a factor of two to compensate for this fact. This means that each day the temporary storage unit should be able to store 12 hours. However a user will not be able to watch all this video at the same day. To make it easy for him we should be able to collect on the disk the TV programs of the last one or two weeks. This is needed when people go on a trip or on vacation. For sure one week should be stored because many people watch programs in the weekend. The storage for one week is therefore 84 hours. We should also offer the consumer sufficient picture quality and with the current (and probably also future possibilities) this will require around 1.5 Gigabyte per hour stored video. This is especially needed when people watch television on larger screens because on those screens coding-artifacts become easily visible. This number of 1.5 Gigabyte per hour is only valid for standard definition television (SDTV). For high definition television (HDTV) at least 4 Gigabytes per hour is needed. Thus this requires 126 Gigabytes for SDTV. This storage capacity should reside in one disc and be instantly accessible. It is not allowed to work with several separate discs, which have to be loaded into a player/recorder. However this required capacity is not unreasonable and probably will be reached in five years from now for acceptable consumer prices. The prime technology for this application is hard disk technology.

But not only the capacity is an issue also transfer rate is needed. We should take into account that the user may also want to store good quality video at SDTV resolution. For this an average bit rate of 4 Mbps is sufficient but a peak bit rate of around 10 Mbps is needed. On the other hand, it is the purpose of the system that it can record and playback streams simultaneously. Also we want no conflicts during recording, thus, when two or more interesting programs are broadcasted at the same time, the system should be able to record them. The following numbers are a good assumption. The system should be able to record three programs in parallel and play back 2 programs simultaneously for different users in the home. This amounts to a total net transfer rate of 50 Mbps. However there will be overhead in the storage system to locate the different sectors on the disk. The model one should work with is that those five streams will be located on the disc at totally different places. This will put the requirement of

transfer rate to and from the storage medium at 100 Mbps (typically of factor of two of overhead should be taken into account). Hard disk technology will be able to offer this performance.

For long-term storage there are also requirements. For this purpose hard disks are not suitable. Users will want to store sufficient information on an optical disc (or magnetic tape) in order to minimize the amount of discs they have to handle. There are no figures available on how much information people will want to keep for a longer time. But our estimate is that this should be at least around 1000 hours. Currently people that love to collect movies have hundreds of tapes in their homes. If a disc or tape holds 10 hours then 100 discs or tapes would be required. At this moment there is a tape technology available that offers this possibility. It is D-VHS that contains 50 Gigabytes on one tape. In the near future there will be an optical disc with 4.7 Gbyte per disc and in the somewhat further future optical discs will become available with 25 Gigabytes capacity per disc.

Additionally to make the system work, another technology is required. This is needed for the automatic recording. We made the calculation that around 12 hours should be stored per day but the offering to the user is much larger. Currently offerings over more then fifty TV channels are common. Fifty TV channels that transmit 18 hours per day deliver 900 TV hours to the home each day. We need to filter by a factor of 80. To achieve this we need three types of technologies: a consistent typology which provides information about each program (its genre and its title for example), a profiling system which collects the preferences of the user(s) at home and a filtering system which decides what should be stored on disc. The same system should also be able to decide in an intelligent way which programs to delete first. Besides research in this area we also need standards for this. Work is now progressing in the TV-Anytime forum (see references) to make this happen. The typology of the programs can be done in two ways. The first way is to give each program a unique identification and then to provide a grouping system for the programs based on the identification number. This approach allows to identify series and similarity between program offerings. This will help to avoid the recording of repeat broadcasts. The second way is to attach to each program a set of characteristics that enable the filtering with the factor 80 (or higher). Those characteristics could be of the type: movie, news, sports, etc. Based on such a filtering one could offer the user a “latest news” service on his local storage. However only “movies” is not selective enough to achieve the factor of 80. We need one more level of detail (but that may be sufficient) such as “romantic, action, etc”. Preferably two levels are implemented each having around 10 categories. Notice that this assumes an equal probability for each category, which is not always the case! This two level approach also makes the selection by a user easier on a TV screen. One more important point is that the typology should be usable in many languages. Therefore the system is best based on a generic typology together with a dictionary for each language.

3 - The technical challenges:

From the above description it may seem that most problems are solved or will be solved soon. Maybe the most urgent tasks will be solved but in this section we will discuss some research topics as well as technological issues that still need further work.

Let us begin with the retrieval problem. In the previous chapters we said that the temporary storage will store at least around 100 hundred hours and the long-term storage at least 1000 hours of video. This however will present a challenge on how to find back the required information. We should not rely on file names or text based search engines to find information. We need a method that is suitable for video information. We need to access information in several steps: first step is to find the correct optical disc or

tape to be inserted in the player, the second step is to find the program and the third step may be to find entry points inside a program. For each retrieval task different methods may be necessary. It would very much help if the typing system, we mentioned in section 2, could not only be used for the filtering task to the incoming information but also for the retrieval issues we will be confronted with. Work is being done in several projects (see AVIR in the references)

Another issue is the parallel recording of several programs. At first sight this may seem simple but for each program to be recorded we need in principle a separate tuner, channel demodulator (in case of digital broadcasts) and an MPEG encoder. Note that for digital broadcasts we need in general a transcoder, which regulates the bit rate of the broadcast. If implemented in a straightforward way this will be too costly for a consumer product. This requirement has initiated research to be able to encode several video streams in parallel with one MPEG encoder.

A third interesting study item is the fast playback of video programs. It is known from movies that are recorded at 24 Hz and broadcast at 25 Hz that this is not noticeable to the user. It is however possible to increase the playback speed much more (up to two times). Of course the user will notice this but the challenge will be to make it acceptable for faster viewing. It may be even thinkable to adopt the speed up factor depending on the content of the video. This has challenges both for the video and audio part of the program.

A fourth challenge is the management of the transfer of video from the temporary storage unit to the long-term unit. We would like that this task is as much as possible automated. This raises several issues. First of all is it desirable that on one disc or tape similar information is grouped together and put in the correct order. This is for example important when a user wants to keep programs that are part of a series. Moreover it would be desirable that the tape or disc storage is used optimally.

A last challenge worth mentioning is the user interaction with such a system. In the future it may become even more challenging when also broadcasters provide their own user interface for selecting and navigation inside their content. The user at home will then have two selection/navigation tasks: one for life broadcasts and one for stored content. If those tasks have to be solved with two different user interaction models, the user may get really confused. Maybe this also will lead the user to only watch TV from the stored content. Then he will have to work only with one consistent user interface.

4 - Conclusion

In the paper it has become clear that cheap mass storage in the home may drastically change the way we watch television in the future. But for it to happen several things must be done in parallel and in a coordinated / agreed way. For a first total system to be able to work most of the necessary steps are being taken and no real new technology must be developed. For a final really consumer friendly system to work, several technical innovations are still necessary but it is foreseeable that they will be solved in the years to come.

5 - References:

Related information can be found at the following web site

http://www.extra.research.philips.com/euprojects/smash
http://www.extra.research.philips.com/euprojects/storit
http://www.extra.research.philips.com/euprojects/avir/
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