The AMUSE Residential Multimedia Trials: Phase 1 Monitoring Results Summary

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Abstract. The European ACTS project AMUSE (Advanced Multimedia Services to Residential Users) carries out ATM-based multimedia field trials in a heterogeneous environment. The AMUSE infrastructure is tested in six European countries under different technical and regulatory circumstances. The trial islands vary in access network technology (Hybrid Fibre-Coax HFC, Asymmetric Digital Subscriber Line ADSL, Hybrid Fibre Radio HFR, and others), terminal equipment (set top box STB, PC, network computer NC) and multimedia services provided. Service usage and user acceptance have been evaluated by automatic monitoring tools and by user questioning after the trial. This paper presents a comprehensive overview of service usage results of phase 1 trials of the AMUSE project.

Keywords: Field Trial, ATM, Multimedia, Network Architecture, Access Network, Measurement

1. Introduction

Within the European ACTS project AMUSE (Advanced Multimedia Services to Residential Users), multimedia field trials have been carried out in six European cities. Their goal was to offer entertainment and information services over ATM-based broadband access networks to residential users. Via their Set Top Boxes (STB) the users had access to Video on Demand (VoD) and News on Demand (NoD) services as well as the World Wide Web (WWW). At this moment all trials of the first trial phase of the AMUSE project have finished their operation and the results are available.

The network architecture, the trials' reference configuration and first results have already been presented in [1]. In this paper we present an overall summary of service usage after completion of the first trial phase. After briefly recalling basic information about AMUSE trials, we present a general comparison of the observed usage data and traffic characteristics for the WWW service.

2. Timelines and Services of AMUSE Phase 1 trials

The AMUSE trials are carried out in two phases. Phase one is used to build up infrastructure and contents. Focus lies on the feasibility and the deployment of available technology. The first phase 1 trial started in May 1996 and the last was finished in November 1997. A detailed description of the trial configurations, the services offered and experiments performed in phase 1 may be found in [2]. Table 1 shows the time scales for the operation phases of Phase 1 trials.

The first phase of the AMUSE trials has now been finished with overall success. A report on major results of the service evaluation of the first AMUSE trial in Munich, Germany, has been published in [3]. Some detailed results on the usage in other trials have been presented in [1] or [4]. A comprehensive summary of all Phase 1 trial results has been reported in the project deliverable [5].

The multimedia services offered in all trials were Video on Demand (VoD), News on Demand (NoD) and Internet access via World-Wide Web (WWW). The usage of these services is covered by our comparison in the next section.

Table 1: Time schedule for AMUSE phase 1 trials

Location	Start date	End date	Number of Terminals	Automatic monitoring
Munich	14 May 1996	19 August 1996	11	YES
Milan	9 September 1996	November 1997 *)	12	**)
Basle	21 October 1996	20 January 1997	10	YES
Aveiro & Lisbon	15 January 1997	27 March 1997	3	**)
Reykjavik	18 March 1997	23 June 1997	10	YES
Mons	2 July 1997	4 November 1997	6	YES

*) trial operated in two sub-phases

**) not analysed in detail

3. Trial Results

3.1. Service Usage Observation from Automatic Monitoring

The trials have been an excellent opportunity to gather data on real residential usage of multimedia services over broadband access networks. Apart from a user survey based on questionnaires and interviews to learn about attractiveness and acceptance of the offered services and interfaces, all requests issued by the users have been automatically monitored and logged. The objective of the automatic monitoring is to establish a usage profile to get an exact picture of when the participant uses the system and what services he uses most frequently. All relevant actions of the users are permanently monitored automatically without additional effort for the user. The summary presented in this paper covers the evaluation of VoD, NoD and WWW services in the trials of Munich, Basle, Reykjavik and Mons, where a detailed analysis of monitoring output has been performed.

In order to compare the usage results between different trial islands we need to consider the usage for the same period of time, e.g. the average usage per day. Additionally, we have to consider the number of connected residential set top boxes (STB) that are accumulated within the total usage time. Table 2 lists all the relevant values for this comparison.

Table 2: Parameters for overall service usage comparison

WWW service	Munich	Basle	Reykjavik	Mons
total usage duration [h:m:s]	137:23:00	283:04:50	88:12:03	52:06:00
length of evaluation period [days]	98	105	46	30...77 *)
number of residential users	11	10	10	6 *)

VoD service	Munich	Basle	Reykjavik	Mons
total usage duration [h:m:s]	75:10:23	23:22:47	264:30:06	126:18:00
length of evaluation period [days]	56	105	46	30...77 *)
number of residential users	11	10	10	6 *)

NoD service	Munich	Basle	Reykjavik	Mons
total usage duration [h:m:s]	5:42:07	1:30:07	0:30:46	3:28:23
length of evaluation period [days]	56	105	46	30...77 *)
number of residential users	11	10	10	6 *)

*) see explanation in text below

The following figures show the corresponding averages broken down to single days and also considering the number of users (i.e. giving the average usage time per day and per STB). Not all users of the Mons trial were connected all the time of the trial operation period. These users were connected step by step one after another. This results in a different evaluation period of service usage between single Mons users. The averages given in the following figures consider this different period length.

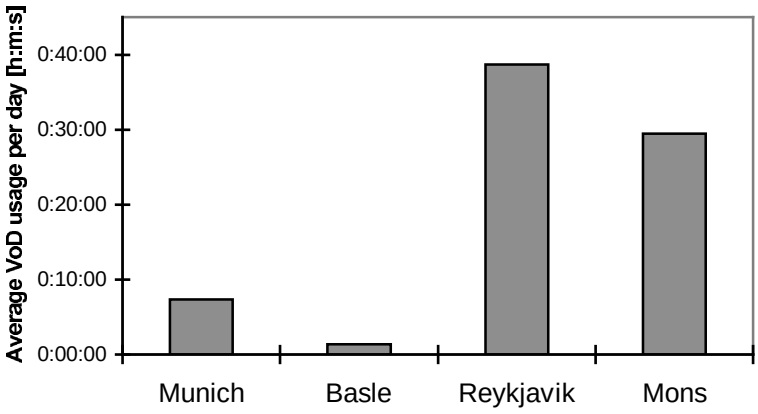

Figure 1: VoD service usage time, average per day and per STB

When comparing the usage of VoD services, Reykjavik and Mons far surpass the other trial islands with a multiple of average usage per day and per STB. This clearly indicates the impact of quality of contents on the acceptance of the service by the users. For Reykjavik and Mons, we found a rather high quality of movie material provided together with a high refresh rate of contents. This becomes clearly visible in the overall usage and the usage behaviour of the residential customers in the corresponding trials.

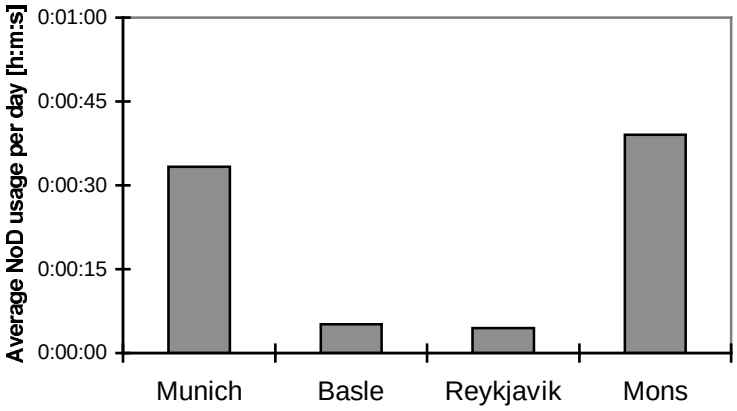

Figure 2: NoD service usage time, average per day and per STB

The use of NoD service in all cases is much less than other services which is perhaps natural, considering the relatively short length of a newscast compared to a movie and the availability of regularly updated news broadcasts on TV. Reykjavik and Basle are similar to each other, Munich and Mons are clear leaders in this category with more than the sixfold of usage. However, the overall acceptance of the NoD service is rather low due to the way of providing this service and the news contents without having an index for particular selection of news items. This statement was underlined by results from the user questionnaires. But even in the Reykjavik trial, where the NoD service provision was improved accordingly during the trial operation phase, the categorisation of news contents did not improve the usage as well in terms of usage time as of number of requests to the service.

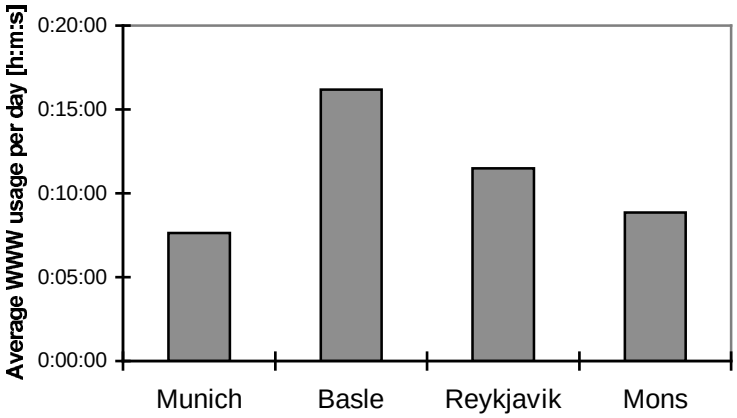

Figure 3: WWW service usage time, average per day and per STB

The WWW service was accepted very well by the users of all trials. In all four trials, the WWW service was offered with an access to the world-wide Internet. The variety of documents and WWW links actually requested by all residential users underline the importance of providing a variety of interesting contents in this service, which was very easy for the WWW service from the content provider's point of view.

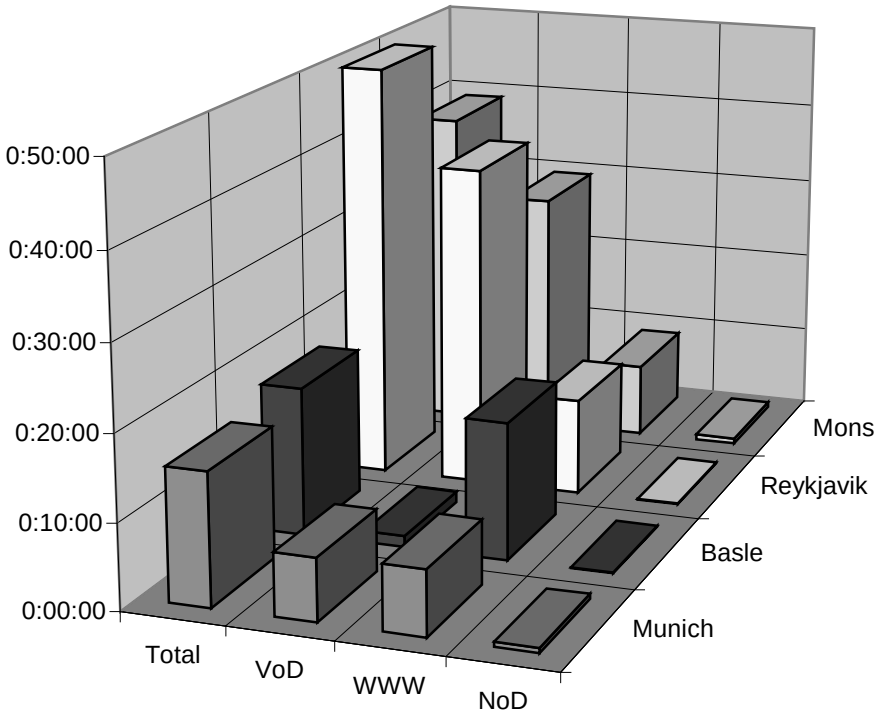

Figure 4: Overall usage comparison, average per day and per STB

Figure 4 shows the information of the previous figures combined for all service categories and additionally indicates the total average usage for all multimedia services for each trial island. It clearly depicts the differences of interest in the services between the trials. The news on demand service was uniquely for all trials the service category with the lowest average usage with considerable difference to the other categories. The usage of the WWW service was fairly consistent across all trials. In Mons and Reykjavik, the average usage of VoD is a multiple of WWW usage. In Reykjavik and Mons, the quality of VoD contents was rather high (e.g. in Mons pay TV contents offered on VoD), which has an important impact on the attractiveness of the VoD service compared to conventional TV services and on the user acceptance of VoD. On the opposite, in Basle the WWW usage is much higher than VoD usage. In Basle, cable and satellite TV is very wide spread amongst the households and for some reasons the attractiveness of VoD contents was limited compared to TV offers. Respectively, the VoD usage was rather low.

3.2. WWW Traffic Analysis

The detailed logdata of the AMUSE field trials allowed to investigate the characteristics of World Wide Web traffic. The analysis of the size and interarrival time of the files requested by a user shows that both values vary strongly. Their behaviour can be described by their complementary probability distribution functions, i.e. the probability of a value being greater than the value on the x-axis.

Figure 5 shows these functions for the request size (file size) for the four evaluated trials. Using a log-linear scale allows to see the characteristic heavy tail indicating a non-negligible probability for very high values.

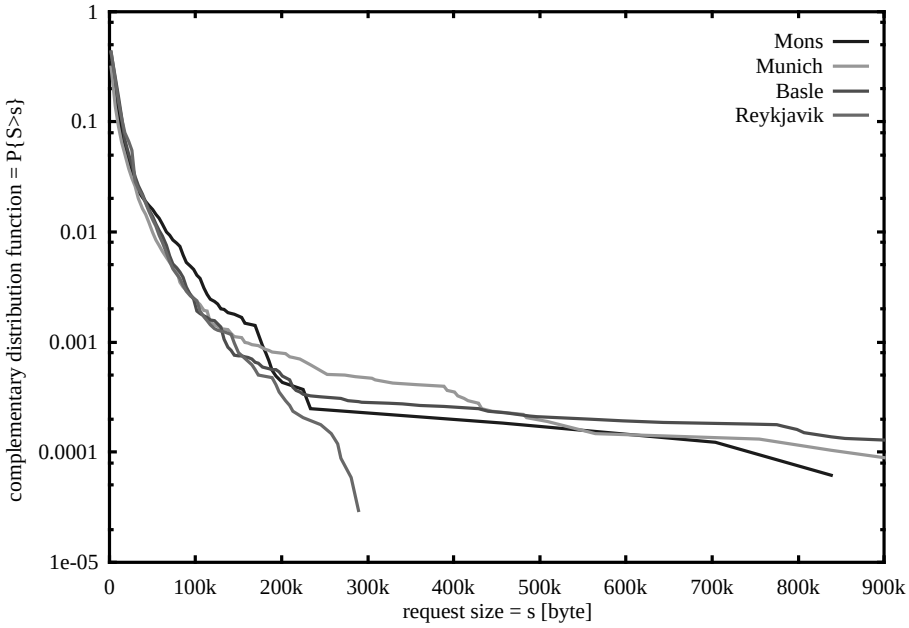

Figure 5: Complementary Distribution Function of request sizes from Field Trials in Munich, Basle, Reykjavik and Mons

The functions for each trial island look very similar which indicates that WWW traffic characteristics have been found. The absence of large requests in the Reykjavik trial can be explained by the absence of extreme users who used the AMUSE trials to download large binaries, images, audio or video files in the other trials.

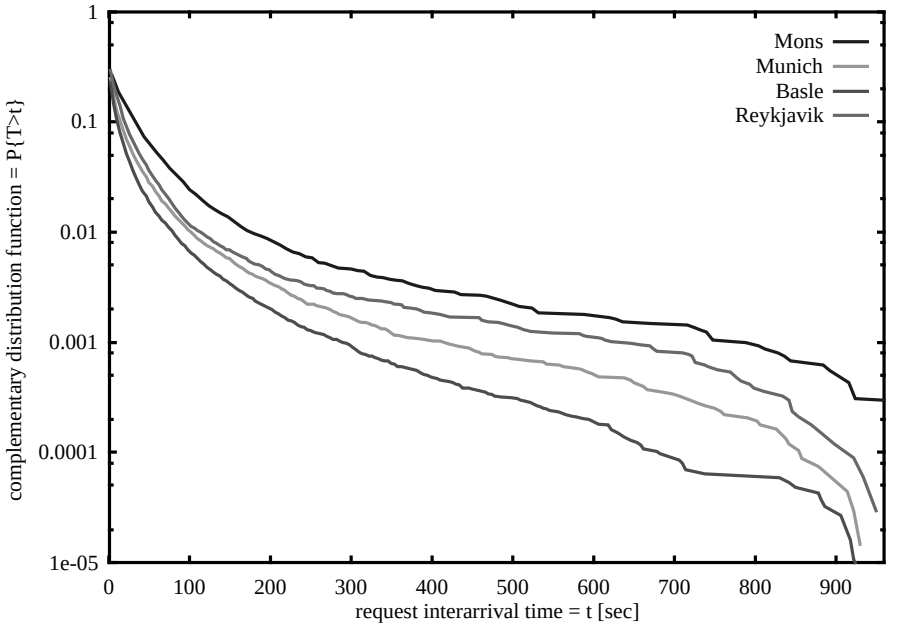

Figure 6: Complementary Distribution Function of request interarrival time from Field Trials in Munich, Basle, Reykjavik and Mons

The complementary distribution functions for the interarrival time show a similar characteristic. Again we found distributions with heavy tails. However, we decided to focus on interarrival times of packets belonging to one session instead of covering the whole trial period. Since the log data includes no indicator of real session boundaries we decided to use

an interarrival time of around 15 minutes to separate consecutive sessions. As a result of this, the complementary distribution functions of interarrival times within a session shown in Figure 6 are cut off at around 15 minutes since no values greater than this have been evaluated.

The shape of the functions in both figures can be approximated by a hyperexponential function of the order three. By using an approximation for packet size distribution and for interarrival time distribution a simple model has been built and presented in [4] and [6]. The model describes user generated WWW traffic during an active session and it is intended for the simulation of larger user populations. However, it does not focus on a careful description of single user behaviour.

To learn about user behaviour on session level an evaluation of sessions has been done for the trial in Mons. Despite of the small number of 119 sessions an interesting general behaviour could be observed. The complementary distribution function of the session interarrival time shows regular steps every 24 hours. This shape indicates, that users had a favourite login time regardless of the number of days that have passed. The mean session length was 32 minutes.

4. Conclusions and AMUSE Phase 2 work

Our paper presented a comprehensive summary of usage results from the AMUSE Phase 1 trials. The VoD and WWW services compete with each other - WWW usage in Basle was higher than in Munich, but VoD usage in Basle was lower than in Munich. The success of VoD in Reykjavik and Mons trials resulted in relatively lower WWW usage than in Munich and Basle. The maximum use of all multimedia-services is limited to about 50 minutes per day (on average). The NoD service usage was not as high as expected from initial user interviews; categorising the news into subjects did not improve the usage. The level of WWW usage was fairly consistent across all trials. Content is everything - the programme content must be good enough to make users want to use the services. If cable TV is available, the content has to be better than the average content on the CATV channels, as can be seen in the Mons trial.

We have investigated WWW traffic on request level and found characteristical distributions for request interarrival times and request sizes. A traffic model that makes use of these findings can be found in [4] and [6].

In phase two the trial islands will deploy more sophisticated services and technology like advanced Set Top Boxes capable of MPEG2 video, state-of-the-art PCs or a HFR access network (Hybrid Fibre Radio) to link to the homes. All phase 2 trials will have their operation phase in 1998, a detailed description of these trials may be found in [7]. Table 3 shows the time scales for the operation phases of Phase 2 trials.

Table 3: Planned time schedule for AMUSE phase 2 trials

Trial Island	Month (1998): J F M A M J J A S	Number of Users	Automatic monitoring
Reykjavik	|======|	>30	YES
Basle	|====|	15	YES
Milan	|======|	15	YES
Munich	|====|	>50	YES
Aveiro/Lisbon	|====|	7	*)

*) not yet clarified

Additional services planned for Phase 2 trials are home shopping, home banking, tele games, educational multimedia applications, info commercials on demand, travel information, travel agency and tele-voting services. Publication of results of the upcoming AMUSE trials is foreseen for the end of 1998.

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