Abstract: This Deliverable is a condensed report of the activities and findings of the CRUMPET trial in Helsinki. It specifies the technical and organisational conditions of the trials, it reports on the activities undertaken and the methods applied, it finally gives an overview of the findings in Helsinki.

A comprehensive and summaric report of all CRUMPET trials will be given in Deliverable 4.4, which will include description and analysis of the user validation results in full detail.

Keyword List: Mobile Tourism Support, CRUMPET trials, user validation
EXECUTIVE SUMMARY

This deliverable is a condensed report of the activities and findings of the CRUMPET trial in Helsinki. It specifies the technical and organisational conditions of the trial; it reports on the activities undertaken and the methods applied, it finally gives an overview of the findings in Helsinki.

The trial in Helsinki mainly concentrated on wireless data communications issues, such as the QoS of data transmission, seamless mobility in the case of roaming between different network technologies. Therefore, the main scenarios of use in the Helsinki trial were different compared to the ones in other trials. In addition, in the Helsinki trial, we used Helsinki-specific content, content adaptation, and GSM-based positioning.

The trial procedure was as follows: 1) Trial people were selected in an ad-hoc manner from a large group of people, who were known to travel a lot. 2) Each participant filled in the first part of the questionnaire and then (s)he was introduced to the CRUMPET system. 3) The trial scenario was explained to her/him. 4) (S)he went through the trial case. 5) Finally, (s)he filled in the last part of the questionnaire.

In the Helsinki trial, the technical validation concentrated on the components and interaction between components that dealt with wireless data communications. The technical validation comprised two phases: In the first phase intensive testing on every component and interoperability between components were carried out. The CRUMPET developers performed the first phase. In the second phase, the technical validation was carried out during the user trial of the CRUMPET system.

Technical validation in both phases proved the overall CRUMPET concept and system to be workable. Each component and interaction between components worked, with minor exceptions, according their functional specifications. The trial proved that software agent technology could be implemented successfully to establish a distributed system that provides its users with adaptive services.
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1 INTRODUCTION

The trial in Helsinki mainly concentrated on data communications issues, such as the QoS of data transmission, seamless mobility in the case of roaming between different network technologies. Therefore, the scenarios of use in the Helsinki trial were different compared to the use cases in other trials. In addition, in the Helsinki trial, we used Helsinki specific content, content adaptation, and GSM based positioning.

The CRUMPET system was available in Helsinki as specified in Deliverable 1.8, i.e. the client agent, monitor and control agents residing on the client device running the microFIPA-OS platform on Linux. The user interface was implemented using the Dillo browser.

The wireless access in Helsinki was achieved by a WLAN hotspot at Sonera premises as well as GSM network coverage allowing wide-range coverage.

The Helsinki trial started on 3rd of October and ended on 4th October 2002. During this time, 10 users tried and validated Helsinki CRUMPET services. All the users had a brief introduction to the system and the scenario to be trialled, and after the introduction the users started to use the CRUMPET services. All users filled in the CRUMPET questionnaire, and in addition most of the people filled in the additional SUMI questionnaire.

The remainder of this report is structured as follows: Section 2 documents the technical conditions of the Helsinki trial. Section 3 gives more details of the trial activities and methods applied. Section 4 reports the findings from this trial, for both the technical validation and the user validation. Finally, section 5 gives conclusions and suggests future work in this area.
2 TECHNICAL AND ORGANISATIONAL CONDITIONS

2.1 Software

The software architecture of the Helsinki trial consisted of four components: 1) the software on the client device, 2) the software on the access node, 3) positioning software, and 4) third party web server software.

On the client device, the MicroFIPA-OS agent platform running on Linux was used, and it hosted three agents, CRUMPET Client Agent (CCA), Monitor Agent (MA), and Control Agent (CA). The browser being used was the Dillo browser. For the video stream, third-party software called vic [http://www-mice.cs.ucl.ac.uk/multimedia/software/vic/] was used.

On the access node the FIPA-OS agent platform running on Linux was used, and on top of it there were the CRUMPET service agents, Dialogue Control Agent (DCA), User Modeling Agent (UMA), Positioning Agent (Helsinki-specific version of GSA and MAPA), CRUMPET Content Adaptation Agent (Helsinki-specific version of CASA), and Service Agent (SA). The UMA and SA used the Helsinki domain and database, and the data was based on the information provided by the Helsinki Tourist Office. In addition, the vic server software was also used in providing the live video feed from one location.

The Positioning Agent used the services provided by the Sonera’s GSM positioning service, which is able to provide the position of a user terminal by GSM cell accuracy.

In order to fetch additional information (e.g. not stored in the CRUMPET Helsinki database), access to third party web services was provided.

2.2 Hardware

The client device was Compaq iPAQ H3630 running Linux Familiar [http://familiar.handhelds.org/] operating system. The memory configuration was: 32MB of ROM and 32MB of RAM.\(^1\) The WLAN controller was Lucent Technologies WaveLAN IEEE 802.11b PC card. The GSM controller was Nokia’s Cardphone 2.0.

The access node was a PC based server (DELL PowerEdge 1300, dual-processor Pentium III, 1024MB RAM) running RedHat 7.3 Linux operating system. An ISDN adapter providing incoming GSM connections was connected to the access node.

2.3 Network Set-up

The network configuration consisted of a WLAN hotspot built using Lucent Technologies base station and Sonera’s GSM network. The WLAN hotspot had well-specified coverage in the indoor trial space.

2.4 Content and Services

The content provided to the test user consisted of Helsinki database, which was based on the information provided by the Helsinki Tourist Office. The content included text and images. The map information was provided by the Sonera Positioning Service and wrapped by the Positioning Agent. The video feed was implemented by installing one video camera providing live video stream from one of the cafeterias listed in the Helsinki database.

\(^1\) See D4.1 for the minimum configuration
3 ACTIVITIES AND METHODS

3.1 Methods

The methodology applied for the CRUMPET trials has been devised in the trial plan, Deliverable 4.1. There have been no major revisions. The user validation is achieved by a field experiment where users use the system to achieve some typical tourism tasks with the support of CRUMPET. This experiment applied a procedure described as follows:

- An introduction was given to the user, which is summarised as follows: “You are a tourist in Helsinki and you have your CRUMPET client with you. First you want to see interesting sites available near you, and after that you may want to find a place to eat. The CRUMPET system is supposed to help you with these activities by recommending interesting places and allowing you to browse information about the places, in the form of text, images, and video”.

- The user was provided with the CRUMPET device and once (s)he got familiar with the device and the user interface, (s)he proceeded to go through the scenario (see Figures 1, 2, and 3).

![Figure 1: The initial welcome screen.](image1)

![Figure 2: The user has logged in to the CRUMPET system.](image2)

![Figure 3: The user has selected the services screen.](image3)

- The user first asked the CRUMPET system for available sights, such as museums, statues, art galleries, and buildings, and received a list of categories (see Figure 4). After this the user selected one category, and continued on watching more detailed information about the sites (see Figure 5). Following the more information link the user was able to get contact information of the sight, a detailed description of the sight, and a map showing the exact location of the specific sight (see Figure 6).
• After browsing the sights the user asked the CRUMPET system for recommended restaurants nearby (see Figure 7). The user was provided with a map (see Figure 8) and a list of the restaurants (see Figure 9). Following the more information link the user was able to browse the food menus, descriptions (see Figure 10) and pictures of the restaurants (see Figure 11), and possibly live video feed from the restaurant (see Figure 12). The user was most interested in the restaurant, which provided the live video, and decided to walk there.

• Once the user walked away from the WLAN hotspot, the CRUMPET client roamed from the WLAN hot spot to the GSM network. After a short break caused by the roaming, the user continued watching the video.
Figure 10: Detailed information about one restaurant.

Figure 11: Images of one restaurant.

Figure 12: Live video feed from one restaurant.
4 RESULTS

4.1 Technical Validation

In the Helsinki trial, the technical validation concentrated on the components and interaction between components that dealt with wireless data communications. The technical validation comprised two phases: In the first phase, intensive testing of every component and component interoperability was carried out. The CRUMPET developers performed the first phase. In the second phase, the technical validation was continued during the user trial of the CRUMPET system.

Technical validation in both phases proved the overall CRUMPET concept and system to be workable. Each component and interaction between components worked with minor exceptions according to their functional specifications. The trial proved that software agent technology could be implemented successfully to establish a distributed system that provides its users with adaptable services.

The results achieved demonstrated that the CRUMPET agent-based approach is adaptable allowing a service agent to be replaced with another service agent giving more enhanced service or operating in a different environment. For example, the content adaptation agent can adapt the different location based content, and in addition the location tracking agent can be selected based on the technology used to track users, e.g., GPS and GSM.

But the technical validation pointed out several issues that need improvement.

Firstly, roaming between different network technologies revealed shortcomings such as long delays and to some extent unreliability. Implementing seamless roaming between different network technologies is a very challenging task requiring solutions almost at each layer of the communication stack. The validation revealed, for example, following challenges:

1) If the operating system (such as Pocket PC) does not support two more data links being simultaneously open, then roaming from one network technology to another requires time consuming operations, thus increasing delays and even in some cases unreliability.

2) Currently, much system software (e.g., operating systems and data communications stacks) lacks open interfaces, which enables proper monitoring of data communications and thus obtaining valid and just-in-time information to reason about data communications and to act properly (e.g., when to switch over to another network or inform upper layers about a long term disconnection).

3) It is challenging to design a user interface that is adaptable enough for many different use cases combined with the adaptation of many different kinds of data that is satisfactory to tourists. This would require much more work than was feasible in the CRUMPET project.

4) This new kind of approach to use simultaneously or almost simultaneously several data communication controllers and connections on handheld computers revealed that designing and implementing software solutions for this kind of environment is very difficult. One of the main reasons is that software platforms for handheld devices are simplified to fit a resource poor environment; for example, support for mobile IP is missing.

The technical validation proved that the CRUMPET system is mature enough to be further developed and implemented as a commercial product. However, the challenges mentioned above must be addressed properly.

4.2 User Validation

The user validation has been performed according to the plan devised in 4.1, and the results are documented in the deliverable D4.4.
5 CONCLUSIONS AND FUTURE WORK

5.1 Conclusions

The Helsinki trial showed that the CRUMPET system both is technically feasible and offers appealing services to tourists. The trial proved that software agent technology could be implemented successfully to establish a distributed system that provides its users with adaptable services. In general, the trial users were satisfied with the CRUMPET services, but in some cases there were complaints about user interface and response times, which require improvements.

5.2 Future Work

The plans for the future work include further development of monitoring the data links and exporting the CRUMPET solutions, especially the solutions of nomadic application support, to the Pocket PC platform. In addition, they also include an analysis of requirements for productizing the CRUMPET system in the terms of needed expertise, training of development engineers, maintenance, and manpower requirements.