MOBY DICK

The Mobile Digital Companion

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Annex I — Project Programme

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Sape J. Mullender
University of Twente / CTIT, the Netherlands

Paolo Corsini
University of Pisa, Italy

Gunnar Hartvigsen
University of Tromsø, Norway

MOBY DICK — The Mobile Digital Companion

Summary

The technologies of PDA, digital cellular phone and smart card, when combined and integrated well, have the potential of replacing all of the things people have to carry around with them by one small device, the Pocket Companion. It is a small portable computer and wireless communications device that can replace cash, cheque book, passport, keys, diary, phone, pager, maps and possibly briefcases as well. The combination of an intelligent information system and a location system engenders many new types of applications, such as admission control, digital chequebook, paging, and an automatic diary that keeps track of where you were and with whom. The design challenges lie primarily in the creation of a single architecture that allows the integration of security functions, externally offered services, personality, and communication. In the Moby Dick architecture, Quality of Service (QoS) is no longer a networking issue alone, but a framework to model integration and integrated management of all the system services and applications in the Pocket Companion. Research issues include: security, power consumption and communication, hybrid networks, data consistency, and environment awareness.

The objective of the first phase is to determine whether all key building blocks of the Pocket Companion and the Moby Dick architecture are feasible. The objectives of the four items that will be addressed are:

* *Security*

  The objective of the first phase is to find out whether our solution, based on smart-card technology, can provide a plausible and integrated solution for implementing fully secure mechanisms in very personal and relatively resource poor machines like the Pocket Companion.

* *Power consumption and communication*

  The objective is find out whether our approach to power management, based on operating system detection and user level control, significantly saves battery power.

* *Hybrid networks*

  The objective is to find out whether we can switch seamlessly between radically different networking technologies in resource poor machines like the Pocket Companion.

* *Data Consistency*

  The objective is to find out whether our solution to consistency control, where the user is part of the decision loop, is suitable for the Pocket Companion, both in terms of the requirements of user involvement and resource consumption.

In the first phase of the project we will implement a small set of applications to evaluate our solutions to a number of key problems and reveal the potential of the system. The knowledge obtained in this phase will be used in the possible second phase of the project to design a system that is capable of dealing with more demanding multimedia applications. Moreover, the demonstration of the applications at the end of the first phase will be a powerful instrument for getting industrial involvement. By showing that we can improve the quality of interaction between people and institutions and between people, we expect to involve the European IT and telecom industry in the possible second phase.

I DESCRIPTION OF THE PROJECT

I.1 Project overview

An exciting prospect for the next decade is the deployment of a new generation of hand-held computers. Wireless networking greatly enhances the usability of these portable computing devices. They will be used as means to participate in an on-line information community. The combination of networking and mobility will engender new applications and services. Not only does it provide a means for users to stay in touch while on the move and to receive notifications of important events, it also gives people a whole new way to interact with the infrastructure of large public institutions, such as airports, supermarkets, or even whole cities. This interaction can be used for information about services, access to them and transactions with them. Standing in line for ticket or teller windows may become a thing of the past. Instead offices and public places will be equipped with access points, through which hand-held computer users will be able to communicate with the existing infrastructure.

The overall goal of the Moby Dick project is to design an architecture that releases the full potential of the Pocket Companion as we envision it. The design challenges lie primarily in the creation of a single architecture that integrates: security functions (e.g.,payment), externally offered services (e.g., airline ticket reservation), personality (i.e., these devices know what their owners want), and communication services.

I.1.1 The Pocket Companion

A small portable computer that is small enough to fit in a pocket or handbag can replace all of the paraphernalia of modern (business) people and make their life much easier as well. Almost everybody carries keys, money, credit cards, diary and driver's licence or rail card on his person almost every day of the year. Many add personal digital assistant (PDA), notebook computer, cellular phone, or pager to their luggage as well. The technologies of PDA, digital cellular phone and smart card, when combined and integrated well, have the potential of replacing all of the things — with the exception of a handkerchief — people have to carry around with them by one small device, the Pocket Companion. It is a small portable computer and communications device that can replace cash, cheque book, passport, keys, diary, phone, pager, maps and possibly briefcases as well. The infrastructure should allow the user of the Pocket Companion to use e-mail and to access information services (e.g. Minitel, Videotext, World Wide Web, stock exchange data) and data networks. In addition, Pocket Companions will provide to their owners access to services relevant to their location. For example, in a railway station, a Pocket Companion can assist in finding the appropriate train, its time and platform of departure and purchasing the ticket.

The hardware basis of the Pocket Companion can be similar to the Personal Digital Assistants or notebook computers on the market today, augmented with a security module and a wireless-network interface. It is important to emphasize that the users will not be specialists and that these hand-held devices will truly be personal machines.

The combination of an intelligent information system and a location system engenders many new types of applications, such as admission control, digital cheque-book, tracking people / equipment, paging, and an automatic diary that keeps track of where you were and with whom.

The rest of the document is structured as follows: first we outline the research issues in Moby Dick. We then present the project objectives in general and for the first phase in particular, followed by an outline of our approach. Finally we present the deliverables and the assessment criteria.

I.1.2 Research issues

In our view, Quality of Service (QoS) is no longer a networking issue alone, but a suitable framework to model integration and integrated management of all the system services and applications in the Pocket Companion.

Any consumption of resources by one application affect the others, and as resources run out, all applications are equally affected. Since communication bandwidth, energy consumption and application behaviour are closely linked, we believe that a QoS framework is a sound basis for integrated management of the resources of the Pocket Companion.

Our approach towards an extended QoS framework is to ensure that the user has the option of being involved at every critical junction. This implies that all the ongoing activities must cooperate to conserve power (when running from batteries) and communication bandwidth usage. One big challenge of Moby Dick is to move the focus of system design from performance (in the traditional sense) to resource exploitation.

Within the Moby Dick project we will focus on the following research issues, while keeping it within a QoS context:

1. *Security*

   Security will play an important role in the design of such an 'open' architecture. The required level of security may change from application to application. It is extremely important that security mechanisms are technically completely sound, so that even computer viruses introduced to the Pocket Companion by software pirating receive no opportunities for causing damage.

   Integrated security modules (e.g., based on smart card technology) for small hand-held devices like the Pocket Companion and wireless networks can provide the basis for a secure and seamless integration of payment services into a broader class of information services. This would allow the user to select services offering themselves over the network, perform authentication, and pay for the used services.

   Security has always proven to be extremely difficult. Both the security mechanisms and the architectural issues concerning integration of the security module in the system are of great importance in the project.

   A vital function of the Pocket Companion will be secure negotiation of contracts with arbitrary services. The form of these contracts will usually be that the party represented by the Pocket Companion agrees to pay a certain amount for services to be rendered. The research will focus on the interaction of at least three parties: the human owner of a Pocket Companion (or the thief who stole it), the Pocket Companion itself, and a service, or another Pocket Companion. The owner of a Pocket Companion will trust its security module, but otherwise no trust between parties need exist for reliable and secure contracts to be signed. Human users of the Companion are explicitly in the "decision loop" in the sense that they see the contract to be signed and it will only be signed with their consent.

   Furthermore, a user will not allow any foreign service on his very personal machine unless security is handled well enough. Vice versa, his machine should not provide services to guest machines either, unless security is guaranteed. In addition to that, user's locations should remain hidden from the overall system, if they so desire.

2. *Power consumption and communication*

   Portable computers in general, but hand-held computers in particular, must be careful not to waste the scarce energy resources in their batteries. Even though battery technology is improving continuously and processors and displays are rapidly improving in terms of power consumption, battery life and battery weight are issues that will have a

marked influence on how hand-held computers can be used for a long time to come. More extensive and continuous use of network services will only aggravate this problem since communication consumes relatively much energy. The determining factor in the power requirement for communication remains distance: the larger the distance over which a transmitter must send, the more energy it needs. Outside buildings, communication over longer distances is sometimes unavoidable, but the amount of such communication can be minimised. Research is needed to provide intelligent policies for careful management of the power consumption while still providing the appearance of continuous connections to system services and applications. Although most mobile applications are or will be designed to function well with variable connectivity, the provision of a virtual connection may be of great importance to porting existing applications to a mobile platform.

3. *Hybrid networks*

   Future mobile information systems will be built upon heterogeneous wireless (possibly overlapping) networks, extending traditional wired networks to hosts moving over a wide area.

   Mobile computers need to be able to move seamlessly from one communication medium to another, for example from a GSM network to an in-door network, without rebooting or restarting applications. It is obvious that when a mobile gets out of reach of a network, switching over to another network is necessary, but this may also be necessary to achieve the highest throughput at a given time or place. The network that is most appropriate in a certain location at a certain time depends on the user requirements, network bandwidth, communication costs, power consumption etc. Changing the communication network will require more than merely making it possible to swap physical networks on-the-fly. Even where such network switching is possible, various communications media have such different properties that some applications will not perform correctly without further adaptation. Research is needed to make it possible, even for small hand-held computers, to implement network services that are inter-operable across heterogeneous networks.

   The project will address architectural issues and find workable solutions that are suited for both system services and applications for small hand-held computers.

4. *Data consistency*

   In a mobile environment it cannot be prevented that the portable will enter areas with very poor network services. It may also enter areas without any services, so that the machine is disconnected. This may happen frequent and in unpredictable ways. Disconnection or low connectivity can also be due to power saving, server disconnection, high connection cost or system faults. Hence, variable connectivity and disconnection must be considered as a primary mode of operation for a Pocket Companion.

   Sharing data with mobile machines that are frequently disconnected is a problem. Disconnections may partition the sharing machines, thus making updates in one partition invisible in an other. This may create inconsistencies. Extensive use of locks to prevent inconsistencies involves all parties, and severely affects progress as parties may not be able to communicate. Dealing with disconnections in such environments involves selecting a proper trade-off between data consistency and availability. For many applications, doing nothing while waiting for connectivity to be restored is unacceptable, but allowing updates on two ends of a broken connection may cause data inconsistency.

   Of particular interest in this project is research into workable but intergratable consistency models that tolerate the inconsistencies introduced by variable connectivity, and

research in how to make applications that are able to deal with inconsistencies in a way that does not surprise users. User interfaces must, for example, be designed to adapt to changes in consistency or availability.

5. *Environment awareness*

   Many applications require that a Pocket Companion is able to find out where it is. One example is an application that provides directions in a town or a building. In addition, we believe it will be vital to a Pocket Companion to be able to find out what services are available in a particular place. This allows a railway station's 'timetable service' to offer its services to any Pocket Companion that enters the station (for instance, by bringing up an icon on the Pocket Companion's screen). It may also be envisioned that a Pocket Companion is able to use the computational or storage resources of the environment to temporarily "amplify" its own services. Research is needed to integrate environmental awareness into system services and applications.

I.2 Project objectives and expected results

I.2.1 Overall objectives

No contemporary architecture and no existing state-of-the-art technology can provide the wealth of services required by a fully functional Pocket Companion. In particular, no existing infrastructure can provide an integrated set of services with the quality and quantity that will be needed. It will not be adequate to use a large set of today's solutions because the Pocket Companion will surely compute while being disconnected, will be turned off or will be disconnected at inconvenient moments, will run out of batteries while in a critical section and will be relied upon to store secret keys and money; all of which today's machines cannot cope with.

The overall goal of Moby Dick is to design an architecture that releases the full potential of the Pocket Companion. The design challenges lie primarily in the creation of a single architecture that integrates: security functions, externally offered services, personality and communication services.

I.2.2 Phase I objectives

The objective of the first phase is to determine whether all the key building blocks of the Pocket Companion and the Moby Dick architecture are feasible. Assessment criteria for these objectives are defined in section II.3.5.

In the first phase we will determine whether our use of QoS is feasible. We will establish this by ensuring that we can realise the main building blocks in our QoS notion. The Moby Dick architecture will be designed with extensibility in mind, since it must be able to accommodate new services, many of which we have not yet considered.

Environmental awareness will not be addressed in phase one, as we believe that it does not pose fundamental new problems in this phase. Although it is vital for the Pocket Companion, it is a higher level service based on the same building blocks as the other issues we are addressing in phase one. The success of the other feasibility studies can also be considered a successful feasibility of this issues. Therefore it is not necessary to address this issue separately in phase one. The service can for example utilise the same power saving techniques as is studied elsewhere, and hence we do not believe that the power consumption of environmental awareness will be significant.

Below we list the objectives of the four key building blocks that we will address in phase one.

1. *Security.*

   The objective of the first phase is to find out whether our solution, based on smart-card technology, can provide a plausible and integrated solution for implementing fully secure mechanisms in very personal and relatively resource poor machines like the Pocket Companion.

2. *Power consumption and communication.*

   The objective is find out whether our approach to power management, based on operating system detection and user level control, significantly saves battery power.

3. *Hybrid networks.*

   The objective is to find out whether we can switch seamlessly between radically different networking technologies in resource poor machines like the Pocket Companion.

4. *Data Consistency.*

   The objective is to find out whether our solution to consistency control, where the user is part of the decision loop, is suitable for the Pocket Companion, both in terms of the requirements of user involvement and resource consumption.