FROM DESKTOPS TO MOBILE DEVICES: HOW COMPUTER ARCHITECTURE IMPACTS DAILY TECHNOLOGY USE

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Annotation: *Distributed multimedia applications running in a mobile environment have a number of special characteristics. Many future wireless mobile systems will operate in various, relatively unregulated environments such as home and workplace LANs with time varying interference levels.*

Keywords: *High instruction reference locality, Coarse-grained parallelism , Programmability, adaptability, terminal, radio modem:*

Topic of this research is the architecture of a future handheld device, called Mobile Digital Companion (in this thesis also referred to as Companion). A Mobile Digital Companion will be a personal machine, and users are likely to become quite dependent on it. The Mobile Digital Companion is a small personal portable computer and wireless communications device that can replace cash, cheque book, passport, keys, diary, phone, pager, maps and possibly briefcases as well [50]. It will resemble a PDA, that is, it looks like a normal PDA, but the functionality and typical use of the system are very different. Typical applications of a Mobile Digital Companion are diary, e-mail, web browsing, note-taking, walkman, video player and electronic payments. The Mobile Digital Companion is a hand-held device that is resource-poor, i.e. small amount of memory, limited battery life, low processing power, and connected with the environment via a (wireless) network with variable connectivity. Our primary objective in designing the architecture has been to support a wide variety of applications for mobile devices that make efficiently use of the available resources. Such companions must meet several major requirements: high performance, energy efficient, a notion of Quality of Service (QoS), small size, and low design complexity he Mobile Digital Companion is more than just a small machine to be used by one person at a time like the traditional organisers and desktop assistants. We distinguish two types of systems: ‘desktop companions’ and ‘Mobile Digital Companions’. A desktop companion is a handheld machine that is designed to give roaming users access to their business data and applications while on the road. Desktop companions are designed and optimised for compatibility and communication with the user's desktop machine(s), e.g. via modem, infrared or a docking station. A typical example of a desktop companion is a PDA or (sub)notebook running Windows CE [26]. The Mobile Digital Companion extends the notion of a desktop companion in several ways. • It will run applications typically found in desktop companions, but it will also run other applications using external public services. A Mobile Digital Companion interacts with the environment and so is part of an open distributed system. It needs to communicate with – possibly hostile – external services under varying communication and operating conditions, and not only to its desktop 'master'. • Multimedia computing will also be an essential part of the Mobile Digital Companion. If a mobile computer has to be used for every day work, then multimedia devices, such as audio and video have to be included in the system. Nowadays, there are several portable multimedia devices available (digital cameras, MP3man, etc.), but all these systems are no more than dedicated devices. What lacks is a good integration between all these devices. • All current desktop companions have communication facilities to communicate with the desktop master. However, as the dependence on network-accessible information storage and computation increases, the desire to ubiquitously access the network requires a much more sophisticated wireless networking capability. The network access should support heterogeneity in many dimensions (transport media, protocols, data-types, etc.). The most important factors, which will determine the success of the Mobile Digital Companion, are the utility and convenience of the system. An important feature will be the interface and interaction with the user: voice and image input and output (speech and pattern recognition) will be key functions. The use of real-time multimedia data types like video, speech, animation and music greatly improve the usability, quality, productivity, and enjoyment of these systems. Multimedia applications require the transport of multiple synchronised media streams. Some of these streams (typically video streams) have high bandwidth and stringent real-time requirements. These applications also include a significant amount of user interaction. Most of the applications we consider require not only a certain Quality of Service for the communication (like high bandwidth and low latency), but also a significant amount of computing power. The compute requirements stem from operations such as compression/decompression, data encryption, image and speech processing, and computer graphics. The Mobile Digital Companion is thus quite a versatile device. Nevertheless these functions have to be provided by relatively small amount of hardware because a main requirement for the Companion is small size and weight. As most current battery research does not predict a substantial change in the available energy in a battery, energy efficiency plays a crucial role in the architecture of the Mobile Digital Companion. An integrated solution that reduces chip count is highly desirable. The approach to achieve a system as described above is to have autonomous, reconfigurable modules such as network, video and audio devices, interconnected by a switch rather than by a bus, and to offload as much as work as possible from the CPU to programmable modules that are placed in the data streams. Thus, communication between components is not broadcast over a bus but delivered exactly where it is needed, work is carried out where the data passes through, bypassing the memory. Modules are autonomously entering an energy-conservation mode and adapt themselves to the current state of resources, the environment and the requirements of the user. The amount of buffering is minimised, and if it is required at all, it is placed right on the data path, where it is needed. To support this, the operating system must become a small, distributed system with co-operating processes occupying programmable components – like CPU, DSP, and programmable logic – among which the CPU is merely the most flexibly programmable one. The interconnect of the architecture is based on a switch, called Octopus, which interconnects a general-purpose processor, (multimedia) devices, and a wireless network interface. The Octopus switch is subject of Chapter 4. Although not uniquely aimed at the desk-area, our work is related to projects like described in [4][20] and [32] in which the traditional workstation bus is replaced by a high speed network in order to eliminate the communication bottleneck that exists in current systems. We first indicate in Section 3.2 the main challenges in mobile system design which will provide the motives why there is a need to revise the system architecture of a portable computer. Section 3.3 then describes the philosophy behind the architecture of the Mobile Digital Companion, and introduces the various basic mechanisms used: the connection-centric approach, the timing control, the Quality of Service framework, and finally presents the basic system architecture. Then we will give an overview of the state of the art in mobile multimedia computing in Section 3.4. Finally, we present the summary and conclusions in Section 3.5. The emergence of novel multimedia applications and services that leverage the growth in mobile computing depends on the availability of a flexible broadband wireless infrastructure. Key technical issues of this infrastructure include Quality-of-Service control and application software integration. Mobile systems will have a set of challenges arising from the diverse data types with different quality-of-service (QoS) requirements they will handle, their limited battery resources, their need to operate in environments that may be unpredictable, insecure, and changing, and their mobility resulting in changing set of available services. The following are the key technological challenges that we believe will need to be addressed before mobile systems like the Mobile Digital Companion will become real. • Energy efficiency – As the current portable computers have shown to be capable of assisting mobile users in their daily work, it is becoming increasingly evident that merely increasing the processing power and raising raw network bandwidth does not translate to better devices. Weight and battery life have become more important than pure processing speed. Energy consumption is becoming the limiting factor in the amount of functionality that can be placed in portable computers like PDAs and laptops. • Infrastructure – The design of mobile systems cannot be done in isolation. The mobile system of the future is likely to be designed to operate autonomously, but it is also very likely that it relies on an external infrastructure to access information of any kind. The mobile will likely encounter many, very diverse environments and various network infrastructures. Furthermore, mobiles may vary along many axes, including screen size, colour depth, processing power, and available functions. Servers (or proxy agents that are placed between mobiles and servers) can perform computation and storage on behalf of clients. Partitioning of functions between the wireless system and servers residing on the network is an important architectural decision that dictates where applications can run, where data can be stored, the complexity of the terminal, and the cost of communication services. • Adaptability – Wireless mobile systems face many different types of variability in their environment in both the short and the long term. Mobile systems will need the ability to adapt to these changing conditions, and will require adaptive radios, protocols, codecs and so on. Adaptive error control and adaptive compression are examples of such techniques. • Reconfigurability – To combat a higher degree of variations in operational environment than is possible with adaptable systems, reconfigurable architectures can be used that allow new software and hardware functions to be downloaded. Thus rather than changing parameters of algorithms to current conditions, an entirely new set of protocols and algorithms can be used. An alternative approach to adapt to a change in environment would be to have a mobile system with all possible scenarios built-in. Such multimode systems become costly, and relatively inflexible. • Security – When computers become more involved in people's personal and business activities security i.e. confidentiality, privacy, authenticity and nonrepudiation become important concerns. Judicious application of cryptography can satisfy these concerns, provided systems provide a secure environment for users in which the appropriate cryptographic algorithms can do their work without any risk of compromising or losing keys or confidential data. • User interfaces – Traditional keyboards and display based interfaces are not adequate for the mobile systems of the future because of the required small size and weight of these system. Instead, intrinsically simpler interfaces based on speech, touch, pen and so forth are more likely to be used and more adequate to the small form factors of these systems. Because these systems will be consumer appliances that are used by non-experts, the complex environment should remain hidden from the user, or presented at a level that can easily be understood by the user. In the remainder we shall focus on the issues that are related to energy consumption, i.e. energy-efficiency and adaptability.

REFERENCES:

[1] Abnous A., Seno K., Ichikawa Y., Wan M., Rabaey J.: "Evaluation of a low-power reconfigurable DSP architecture", proceedings 5th Reconfigurable Architectures workshop (RAW'98), March 30, 1998, Orlando, USA. (URL: http://xputers.informatik.unikl.de/RAW/RAW98/adv_prg_RAW98.html)

[2] Abnous A., Rabaey J.: "Ultra-low-power domain-specific multimedia processors", VLSI Signal processing IX, ed. W. Burleson et al., IEEE Press, pp. 459-468, November 1996.

[3] Adam J.: “Interactive multimedia – applications, implications”, IEEE Spectrum, pp. 24-29, March 1993.

[4] Adam J.F., Houh H.H., Tennenhouse D.L.: “Experience with the VuNet: a network architecture for a distributed multimedia system”, Proceedings of the IEEE 18th Conference on Local Computer Networks, pp. 70-76, Minneapolis MN, September 1993.

[5] Agarwal A.: “Raw computation”, Scientific American, pp. 44-47, August 1999.

[6] Balakrishnan H., et al.: “A comparison of mechanisms for improving TCP performance over wireless links”, Proceedings ACM SIGCOMM’96, Stanford, CA, USA, August 1996.

[7] Barham P., Hayter M., McAuley D., Pratt I.: “Devices on the Desk Area Network”, March 1994.

[8] Benini L., De Micheli G.: “Dynamic Power Management, design techniques and CAD tools”, Kluwer Academic Publishers, ISBN 0-7923-8086-X, 1998.

[9] Berkel K., et al.: “A fully asynchronous low power error corrector for the DCC player”, Digest of Technical Papers, International Solid-State Circuit Conference, pp. 88-89, 1994.

[10] Bhoedjang, R.A.F., Rühl T., Bal H.E.: “User-level network interface protocols”, Computer, November 1998, pp. 53-60.

[11] Bosch P.: “Mixed-media file systems”, Ph.D. Thesis University of Twente, June 1999.