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Wireless Home Network Infrastructure for Wearable Appliances

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Abstract

A server infrastructure allows wireless wearable appliances or portable handsets to access consumer services offered via the server. Services are accessed via a Universal Home Services Interface (UHSI) which is shared by all access devices. The UHSI can include a voice-activated interface to simplify usage from non-graphical terminals. In a home network the infrastructure resides on a home gateway or central home computer and allows users access to local subsystems or external WAN services.

1. Background

There have been many advances in Home Networking over the past decade. There are now many different ways and means to interconnect and interlink consumer appliances in the home environment. New physical layer technologies allow reliable data transfer between multimedia appliances at much faster data rates than before and as even simple 8-bit microcontrollers are now able to implement TCP/IP a standard network glue for heterogeneous home networks is emerging.

Early generation appliances typically relied on a hard-wired connection to a desktop computer in order to communicate with the outside world, but most present-generation appliances have their own inbuilt communications transceivers: infra-red, 802.11b, Bluetooth or GSM/GPRS. With each new generation home appliances will become more independent and capable.

In this context of a new generation of mobile heterogeneous appliances we can see a rapidly emerging need for the users of such devices to gain access to new multimedia and data services. Hence we predict a need for a new broadband infrastructure to enhance the capabilities of such devices. Where better to start with such an infrastructure than in the user's home?

2. Overview

In this paper we propose a server-based infrastructure to provide services to users of a wireless home network from their PDA, mobile phone, or even a wearable appliance. Our vision is that modern PDA's and mobile phones will evolve into wireless data-access and entertainment control terminals and that much of the computing power accessed by consumers in the home will reside on a central home gateway server. This server will control much of the multimedia and entertainment systems in the home and could also provide a range of home automation services, and access to broadband Internet services. The data/service-access terminals are in most cases be relatively simple devices serving only to provide a user-interface to the main service infrastructure supported on the server. An overview is presented in fig 1 below. We see that a common unified home services interface (UHSI) to the home server is shared by a home-PC and other user access devices in the home. The importance of such a common UHSI is dealt with in the next section of this paper.

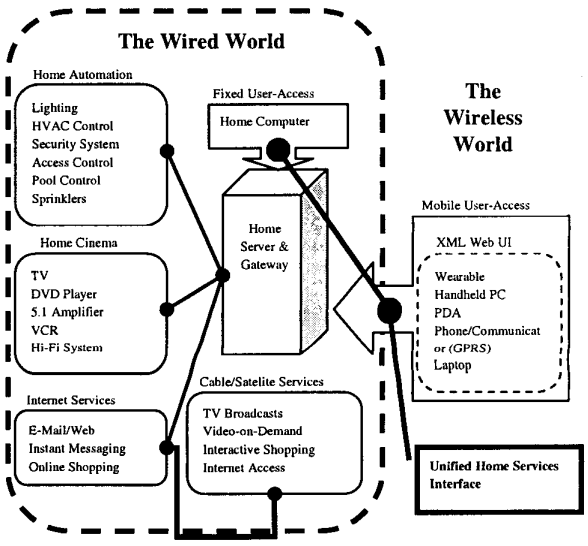

Fig 1 User access to a Home Network and its related services via a common, unified User Interface available on a range of mobile and handheld devices.

3. A Unified Home Services Interface (UHSI)

In this section we develop some ideas regarding current user-interfaces in the home environment and discuss the confusion caused to consumers by the plethora of user-interfaces available on today's consumer electronics appliances. A particular goal of this paper is to examine how a UHSI might be implemented in a practical home network based on today's technologies.

There are a number of industry initiatives which are related to our quest. These include the *Open Systems Gateway Initiative* (OSGi) and the *Universal Plug and*

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Play (UPnP) organisation to name some of the more prominent industry groupings. We will examine a number of these initiatives as a basis for our own work. Where practical it is our intention to adopt and use such industry standards, but adding complimentary enhancements where it is felt they are lacking.

A core aspect of this paper describes our ongoing work to develop a prototype of a UHSI suitable for use on wireless handheld PDAs or on wearable data-terminals. We have focussed on making the user-interface for such a hand-held or wearable data-terminal as simple and intuitive as possible. To this end we have been impressed with the potential of using voice-activated interfaces for home services. A detailed description will be given in the final paper.

4. Server Infrastructure

A wireless access device connects to the home network via a modified DHCP server. In addition to obtaining its own IP address and those of the local gateway and DNS servers it also receives an address for a UHS server. The UHS server contains a registry of available services which have been registered in a local database. Consumer appliances which are connected to the Home Network should register with the UHS server in order to make their services/functionality available via the UHS interface on a handheld client.

We have used SOAP/XML to implement our initial prototypes and some discussion will be included on the pros and cons of this approach and on alternative web technologies which could achieve the same functionality. We have found that the *Universal Plug and Play* (UPnP) standard covers much of the required functionality and thus we have adopted, where appropriate, the conventions and XML templates outlined as part of the UPnP industry standard. Some discussion is included on adapting UPnP to support an enhanced UHSI with a particular emphasis on adding voice activation support. In addition we will discuss some alternative approaches, including a thin-client infrastructure using the open-source *Virtual Network Computer* (VNC) software.

5. Usage Scenarios

From the perspective of an end user they will gain access to any UHS services, via the local UHSI, as soon as their handheld or wearable computer connects to the local home network. When they browse to the address of the UHS server they will see a menu of available services rather than a list of devices or home appliances. Selecting a service will then provide the user with a menu enabling the different capabilities of a particular service.

In addition to the browser-menu interface we also provide a generic, device independent, voice-activated interface. This is interesting because it allow hand-free operation and allows users a more natural and relaxed means to control their home environment – for example, they can turn the TV on and select channels using spoken commands ("TV on"; "Channel 106 please") without burying their heads in their mobile phone or PDA screen.

Because the main voice recognition is implemented on the server this interface can run on practically any handheld, PDA or phone-like appliance which implements TCP/IP and provides a microphone to enable voice capture. Alternatively, when a more complex service has to be selected the user has access to the full graphic capabilities of a handheld data-terminal if required. Some of the principle components of our proposed home network are:

Universal Home Services Server: The home server will connect to several physical home LAN media and serve as a bridge for these media. Media used includes IEEE 802.11 wireless, a power line network, a phone line network, and IEEE 1394.

An Internet Gateway:. This device could be a standalone gateway device or be implemented as part of the main home server. Services provided by this device might include Internet access, a Dynamic Host Configuration Protocol (DHCP) server, a DNS proxy and a data storage service for pictures, video and other user data.

Smart Appliances: These might include a clock radio, a coffee pot, and a microwave oven - all plugged into the power line network. A home security system would be another example of smart home appliances.

A Home Entertainment System: The home entertainment system includes several devices connected together via IEEE 1394 and connected to the main home server. Components might include a stereo system with a tuner, receiver, and CD jukebox player; a TV and VCR; and connections for additional A/V equipment such as video or digital still cameras.

6. Benefits to Consumers/End-Users

Finally we discuss the implications of this new "holistic" approach to a user interface for the home environment. In particular we discuss how the UHS server provides a means to eliminate the phenomenon of "remote clutter" where the family living room is a jumble of remote controls for a stack of home entertainment appliances.