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Author(s)	Corcoran, Peter; Desbonnet, Joe
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Browser and Applet Interfaces to CEBus Networks

Peter M. Corcoran and Joe Desbonnet.

Dept. of Electronic Engineering, University College, Galway

Abstract

The design and implementation of a Web-browser based interface to CEBus networks is described. The interface supports browsing and navigation of a CEBus network and the user can interact with CEBus devices on the network, and access and control CAL context and object structures within these devices.

The interface can be used to access a local CEBus network from a standard desktop PC, or from a Web-TV or set-top box system with built-in CEBus interface hardware. Furthermore, as the interface is implemented using conventional Web-browser technology it can also serve as a full Internet interface to a home network which provides an Internet/CEBus gateway. Such a system can provide access and control services to the home network from any computer with an Internet connection.

1. Introduction

The Consumer Electronic Bus (CEBus®) is a multi-media LAN standard developed for home automation applications [1]. In earlier work we discussed some of the issues involved in providing access to a CEBus network from a conventional Web browser and Java® virtual machine JVM [2]. The aim was to demonstrate that WAN access to a local control network was practical and broadened the scope and range of applications of CEBus® networking technology.

However we note that the market penetration of CEBus® technology has remained slow, apart from certain niche applications. The authors feel that this is largely due to a combination of the end-user perception of the benefits of home networking and a reluctance on the part of consumer electronics manufacturers to take a chance on applying the technology in unproven markets.

Further, drawing on the recent example of the mass public acceptance and, indeed, obsession with the Internet, we argue that the lack of a usable and readily available user-interface to CEBus® networks is a key reason for poor user perceptions and lack of market penetration. In this paper we offer a preliminary approach to the issue of providing a suitable user-interface to CEBus® networks.

2. Philosophy and Design Issues

In this section we give an overview of the issues involved in providing a useful, but non-trivial user interface to a CEBus® network and the individual devices which are members of the network. It is important that any such interface is user-friendly and

can provide generic access to the broad range of consumer appliances found in a modern home.

In addition we focus on the needs and requirements of the manufacturers of consumer electronic products. They require a means to differentiate their products and to provide user-friendly access to complex features. It is also important that manufacturer have the flexibility to change and adapt the user interface, ideally without requiring that devices be upgraded or otherwise serviced.

It is also noted that many consumer appliances are not yet sufficiently intelligent to support full internet connectivity or to present a high-end graphic user interface (GUI) to the user.

Consideration of the above issues has led us to the consider the interface and Internet/CEBus® gateway architectures described in this and a companion paper [3].

3. System Architecture

An overview of the system architecture is given in *fig 1* below. In its present implementation the system is implemented on a desktop PC platform, but as all of the key system software is coded in a platform independent language the core system elements are suitable for down-sizing and porting to the embedded hardware platforms used for Set-Top-Box or Web-TV appliances.

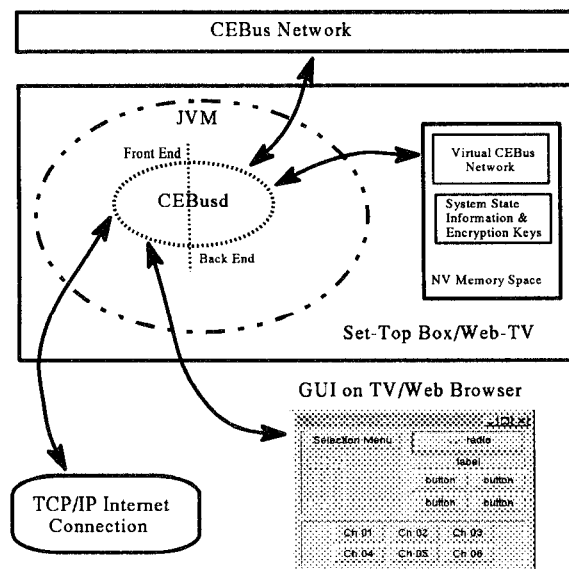


Fig: 1 Overview of System Architecture and UI

The software architecture of the Internet/CEBus® gateway is described in detail in a companion paper. Briefly a system daemon, CEBusd, continually monitors the traffic on a local powerline network. As devices initiate or receive messages, coded in Common Application Language (CAL) this system daemon records the state of network devices in a local registry of devices. Thus state information for the local CEBus® network is available without the need to query individual devices.

The user interface has two distinct components. Firstly there is a graphical browser for the local CEBus® network. This browser simply shows the list of network devices registered in the local database, in the same way that file management utilities show a list of files in a local filesystem. However when a device is accessed in the browser the user-interface for that device does not originate from the local system software - instead it is loaded, as an applet, from an HTTP-style universal resource locator (URL).

This scheme allows the local Internet/CEBus® gateway to provide user-interfaces to an unlimited number of different consumer appliances. Further more it satisfies the manufactures requirements to be able to customize and differentiate their products by creating unique user-interfaces and product features.

4. Implementation of the User Interface

Prototype implementations of the user-interface elements describe above have been developed on a local TCP/IP network and interfaced with a local powerline CEBus® network. The gateway is implemented on a standard desktop PC and the interface to the powerline network is via the RS-232 port and a proprietary interface module. The PC is connected to the TCP/IP network using standard thin-wire ethernet.

In its normal mode of operation the CEBusd daemon program monitors the local CEBus® network traffic and records and registers new devices. It can also register and interact with active *virtual devices*. User access to the registered devices is via the browser interface described in the next section.

4.1 The CEBus Network Browser

The browser described in this section is somewhat more sophisticated than we would expect to see in a home user's system. In fact it provides access to the entire context/object/instance-variable structure of a CAL device. The user interface is illustrated in **fig 2** below.

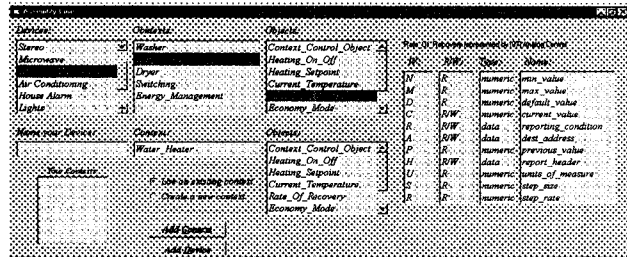


Fig: 2 CEBus Network Browser UI

4.2 User Interface Elements

Due to space constraints we will not describe these in detail in this paper summary. However user-interface elements are essentially applets which can be uploaded from a URL on a TCP/IP network and attach to a network socket on the local PC. Each applet attaches to a specific socket which is mapped onto a local CEBus® MAC address. Thus a one-to-one mapping between user interface elements and local network devices is maintained.

4.3 User Interface Services

Again space constraints preclude a detailed discussion. In brief the CEBusd daemon provides the necessary functionality and services to user-interface elements for CAL packets to be transparently carried between local CEBus® devices and the user-interface applet.

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