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<td><strong>Publication Date</strong></td>
<td>1999</td>
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<td><strong>Link to publisher's version</strong></td>
<td><a href="http://dx.doi.org/10.1109/ICCE.1999.785267">http://dx.doi.org/10.1109/ICCE.1999.785267</a></td>
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<td><strong>Item record</strong></td>
<td><a href="http://hdl.handle.net/10379/4025">http://hdl.handle.net/10379/4025</a></td>
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<td><strong>DOI</strong></td>
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Home Gateway Architecture for Generic Multimedia Services

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Abstract - Development of a prototype residential gateway based on low-cost off-the-shelf PC components is described. The goal is to show how such a gateway might operate to satisfy the requirements of a broad spectrum of customer requirements, from basic remote metering to full multimedia services. It features network enabled BIOS extensions or OS Kernel Extensions, which allow most of the gateway operating system modules and services to be loaded remotely from a head-server over a network link.

1. Introduction
The recent expansion of the Internet Technology has the potential to revolutionise our lives into the 21st century. With the advent of switched broadband services and the de-regulation of the provision of domestic information services a new opportunity is opening for Utilities and information service providers. A key issue, however, is the interface between external information networks and the home environment. One potential solution is through a residential gateway, an electronic sub-system which provides interface and routing services and some management functionality to distribute and regulate the use of information services in the home.

There has been much talk about a generic home gateway but all of today's solutions are proprietary. Furthermore they are limited to a specific set of network services. the exact subset of services will depend on whatever the gateway provider is a cable operator, a telco or another utility. Thus we can see a situation arising where consumers will need a "stack" of different set-top-boxes and satellite decoders to access all the different services they require.

One of the core difficulties in putting a home gateway in place is the uncertainty as to the services and facilities which consumers will come to demand in the medium to long term. Because of the large base of gateways which a service provider must install there is considerable risk if new, or refined services are required by customers. Thus a practical home gateway must be inexpensive, easily maintainable from both software and hardware perspectives and should also be easily upgradable to meet market demands for new multimedia services.

In this paper we describe a prototype of just such a home gateway. The unit is based on a standard PCI bus hardware architecture. It features network enabled BIOS extensions or OS Kernel Extensions which allow most of the gateway operating system modules and services to be loaded remotely from a head-server over a network link. Thus all aspects the system can be upgraded at the server end.

In addition the gateway system can detect new PCI hardware and dynamically load the relevant device drivers over the same network link. Thus installing a new multimedia service is a matter of installing a new PCI hardware module and restarting the gateway.

2. System Architecture
The goal of a Residential Multimedia Gateway is to provide an interface between the access and in-home networks. It provides real-time delivery of the voice, video and data streams from each of the networks. Such a gateway should have an open architecture to help promote interoperability throughout the networks.

![Fig. 1 Home Network/Internet Infrastructure](image)

Remote access to a home network from a computer with an Internet connection, using a Internet/Home Bus gateway is already possible [1, 2]. Fig.1 shows a Home Automation Network in an Internet-enabled household.
An embedded Interface - Gateway can link a variety of home automation and multimedia networks. User access is via any PC connected to the WAN, or low-end Internet-Appliances (IAs) or set-top-box/TV combos.

Our home gateway interfaces with the external networks via an appropriate network interface unit (NIU). The gateway will provide two key gateway/bridge/switch functions:

- the physical interface to terminate all external access networks to the home, with multiple residential services being delivered over each type of access network (Fibre, Co-Ax, ISDN)
- the enabling platform for residential services to be delivered to the consumer, for example, television, and PC networking, or the termination point of internal home networks.

3. The Gateway Operating System

For our experimental setup we use the Linux operating system, which is a Unix clone operating system. Linux is developed under the GNU General Public License, and its source code is freely available to everyone. This, along with its very good stability and real time capabilities (RT-Linux) makes this OS a good candidate in developing low cost home gateways.

The OS kernel allows us to dynamically load and unload components of the operating system, mostly device drivers (such as network drivers) whenever these are requested by the different daemons running on the home gateway. Dynamically loading code as it is needed is attractive as it keeps the load of the home gateway at a minimum and makes it easy to update different modules from a remote server, without rebuilding the kernel and rebooting the home gateway.

4. Conclusions

In this paper we show the potential advantages of building a generic multimedia home-gateway which leverages the PCI bus architecture found in all of todays PC’s. This prototype offers a solution which meets the key goals of a cost-effective, low-maintenance, upgradable home multimedia gateway.

By using PCI the gateway takes advantage of the wide base of PC hardware to support 100baseT Ethernet, ATM and Firewire network solutions. Analog TV services can be provided from standard PC-TV cards and a variety of telephony services can also be implemented using standard PCI hardware.

Significant potential exists to apply such technology to the development of added-value services for the next generation of consumer electronic products for the home.

REFERENCES

