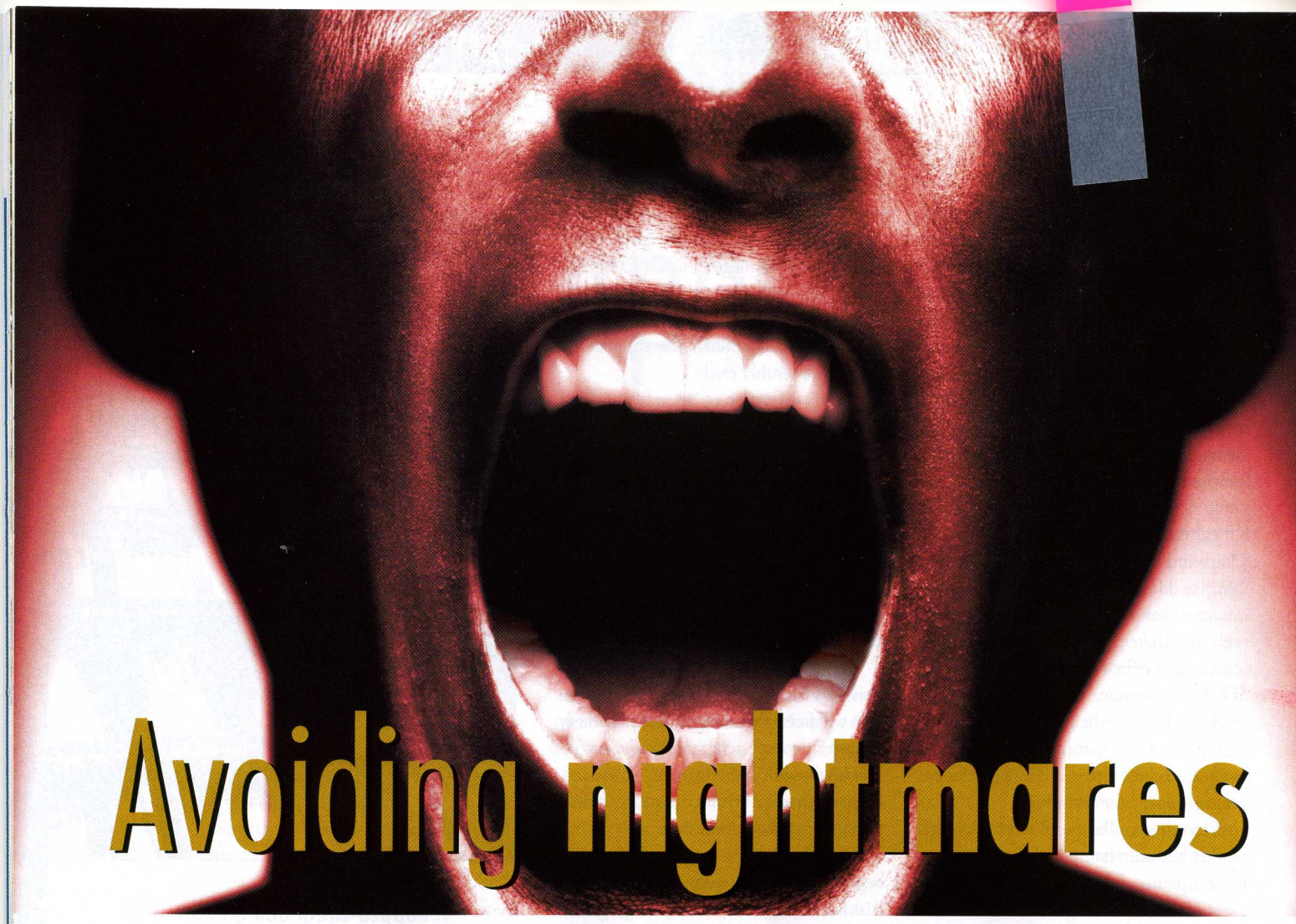


Avoiding nightmares

How programmable logic can be the 'glue' that solves interface standards nightmares. By **Trien Doan**.

The 'Smart House' is more of a reality than ever, although there is still much to be done. A ubiquitous internet and an abundance of high tech gadgets are fuelling consumer demand for integration and automation in the home. For these consumers, the watchwords are convenience and automation.

Advances in electronics have increased the desire to integrate consumer electronics and increase automation in the home. However, the initial smart houses will be automated, rather than capable of interactive intelligence

The home automation market is projected to reach $85billion by 2011, up from $14bn in 2005 (*ABI Research, May 2006*). More and more companies are announcing products that range from lamp modules to remote car starters to garage door openers to wireless routers, and these products are an endorsement of a variety of home automation interface standards such as X10, Insteon and Z-Wave. The convergence of these products and their interface standards will be a key factor if the home automation market is to meet the its projected steep growth.

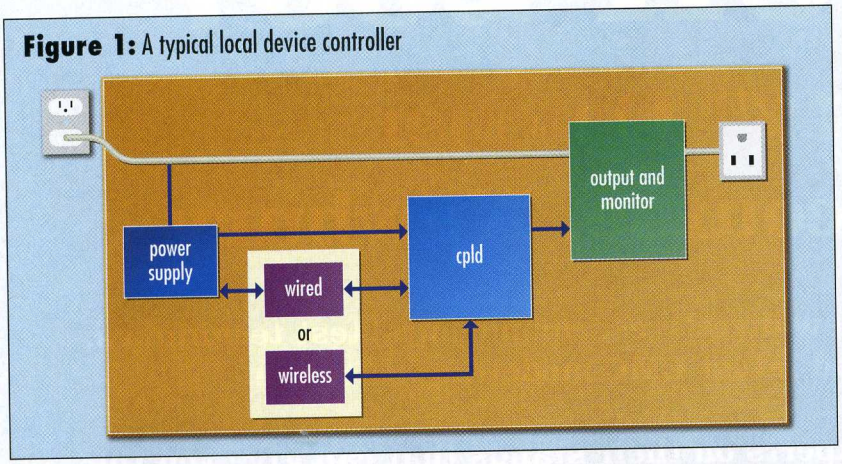
Fortunately, there is an elegant response to the challenge of supporting all these interface standards: programmable logic devices (plds). Programmable logic was born as a quick fix electronic 'band aid', known more commonly as 'glue logic'. Since their inception, plds have helped countless designers meet their production schedules by adding simple glue logic to fix asic bugs, avoiding costly board redesigns.

A field programmable gate array (fpga) is a good choice to bridge various interface standards or to provide a microcontroller interface. Additionally, intellectual property (IP) cores offer predefined interface standards that can easily be incorporated into an fpga, reducing development time. For example, IP for the IEEE802.11 wireless interface is readily available for use in fpgas.

Component cost is typically a key factor in any system design and it is no different for home automation products. Today's fpgas offer design engineers a low cost logic fabric that delivers medium range performance. Low cost fpgas today offer a wide range of logic capacity, exceeding 100,000 four input look up tables (LUT), with on board memory, digital signal processing and serdes functionality to accommodate many complex designs. Furthermore, to save cost a simple soft microprocessor IP core can be used in favour of a more costly traditional implementation using an external microprocessor.

In a home automation system, appliances and equipment in the home are connected to local device controllers plugged into a standard power outlet. These local controllers will manage communications to the home automation gateway via power line communication

Figure 1: A typical local device controller



protocols such as X10 and Insteon. Other home equipment that is equipped with Z-Wave can communicate wirelessly via the low power 9.6kbit/s Z-Wave communication protocol. Inside the automation gateway, an fpga is used to integrate and bridge all these home communication interfaces, as well as to wireless protocols such as 802.11, which enables access to the internet.

Each local device controller uses a complex programmable logic device (cpld) to implement control functions and provide additional logic to integrate other housekeeping requirements such as device status management (see figure 1).

Recent notable applications of home automation are economical remote control (Z-Wave) and wireless home monitoring via the internet. The latter requires a bridge between the home control protocols and Ethernet. Using an fpga allows incorporation of the Ethernet IP, a soft processor and the home protocol application layers, all of which can be included in a single fpga. An implementation of this type results in a very small, cost effective solution in home control bridging applications.

Another possible implementation is a multizone HVAC home automation system. In this arrangement, each zone thermostat communicates to the main thermostat, which then communicates with the home automation gateway. This implementation allows remote control of individual zones via the internet. Central to this application is an intelligent home thermostat. This system has local and remote temperature monitoring capabilities, as well as a local lcd that can display graphical and video information. All the digital functions are embedded in a non volatile fpga that will bridge all home automation communication standards.

Changing standards

As interface standards change, the fpga's inherent flexibility and reprogrammability permit implementation on a single platform; this enables manufacturers to tailor features and options for each model of the automation gateway, from basic to full feature, using the same fpga. Further, fpga manufacturers offer density migration within the same package footprint – more logic capacity can be had within the original pcb design, extending the life of the electronic platform as system requirements change.

The result is inventory simplification and volume pricing, which leads to additional cost savings for development, production, servicing and logistics.

The acceptance and growth of consumer electronics has spawned new industries and transformed those in existence, as well as shortening the life of others. The automotive industry is one that has benefited from the rapid evolution of consumer electronics. Over the past two decades, the electronic equipment in cars has become an increasingly larger percentage of the purchase price. The integration of electronics within the automobile, as well as for home automation, makes the consumer's life simpler even as it complicates life for design engineers.

There is already a thriving smart home industry that is ready to provide products to home automation enthusiasts. More and more home automation products are introduced every year, such as security systems, home appliances, motorised window coverings, lighting controls and home video and audio equipment – all requiring the interface bridging solution that programmable logic devices provide.

The overarching goal of the Smart House is to give the occupant total control of the home's environment. With ready access to the web, homeowners can now have full remote control of their home, allowing monitoring of all home activities as well as simple operations such as turning lights or appliances on and off, from anywhere in the world. Incremental steps towards an intelligent home are taking place today. Academic studies – such as Georgia Tech's Aware Home – will help make the interactive intelligent home a reality. The intelligent home will monitor and record each person's daily routine, both to establish triggers for actions and to remember individual preferences, in order to tailor the home and its appliances for each occupant – from room temperature to light intensity to video and audio.

> "... all requiring the interface bridging solution that programmable logic devices provide."
>
> **Trien Doan, Lattice Semiconductor**

Whether for today's remote control home or tomorrow's interactive intelligent home, programmable logic is a perfect complement in home automation designs, providing home automation design engineers with affordability and flexibility in their quest to provide products that improve the quality of home living.

Author profile:

Trien Doan is a product marketing manager with Lattice Semiconductor.