

Digi Custom Design for Embedded Hardware and Software Development

White Paper

Abstract

This paper discusses the challenges of using modern development platforms for embedded device development and how Digi Custom Design can simplify the development process.

Introduction

The challenges of embedded device development have grown over the last few decades. In the past, it was typical to use 8- or 16-bit microcontrollers to create the functionality of an embedded device. These systems typically were programmed in Assembly and C, and used either no embedded operating system, or a simple event scheduler developed in-house. At some point these designs must be replaced by the next generation. This replacement creates some new problems, as the development organization needs to adapt to new requirements.

When the organization is handling new product development or product updates by using existing technology as a building block, it is relatively easy, as big chunks of existing code can be reused. However, in the last decade the paradigm has shifted from isolated systems to network connected devices. This new paradigm is advantageous for many devices, because the management and usefulness of the information created increases when that information is available on the network. The drawback is that such systems need to integrate themselves into the network infrastructure and need to adhere to the standards in these networks. This is the reason that most of these devices are developed using a standard Real-Time Operating System (RTOS) or an off-the-shelf operating system such as Linux® or Microsoft® Windows® CE.

Challenges of Using Modern Development Platforms

These operating systems make life easier, but can create an additional hurdle by increasing the time needed to start-up in this new environment. Instead of having code sizes of less than 1 MB, suddenly the whole project uses from 16 MB to 128 MB of image size. The large size requires applications and middleware to be configured and adapted to the specific application. Instead of cranking out code as before, the developer must understand the existing application framework and how it can be adapted to specific situations.

In a typical customer scenario, developers must perform ongoing support tasks while also finding time to learn about the infrastructure required for the new project. This can place a large burden on an organization's available development capacity. Marketing typically demands a very short product development timeframe to stay competitive, so two- or three-year development cycles are a thing of the past. Projects now require highly compressed development timeframes of months rather than years.

With the increased size also comes increased complexity. Developers also may realize that they cannot be the master of everything and be successful. Deciding with whom to partner and understanding what parts define the core competency of the developer is as crucial as knowing how to code and which software to write. Developing everything from scratch is just not feasible anymore, so knowing what to make – and which things to outsource – is very important.

Services as Products: An Industry First

How can Digi help in this environment? Since 1985, Digi has been developing products and adding connectivity to embedded devices. The Digi engineering team has a firm understanding of what drives product sales in the embedded device connectivity market and the difficult choices a system developer must make.

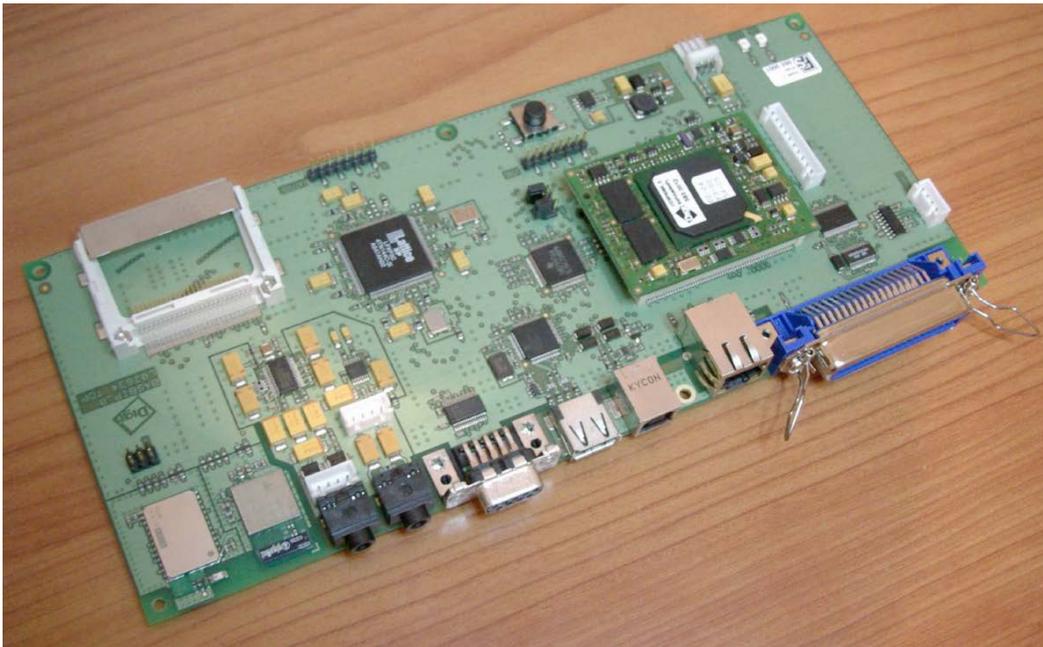
By providing basic building blocks such as embedded modules with supporting software infrastructure, Digi enables companies to concentrate on their product specifics, without spending too much time for the basic building blocks. In addition to standard Development Kit offerings, Digi also offers customer specific consulting services. Digi Custom Design starts at simple support contracts that enable the customer to keep his software infrastructure current. When using standard operating systems such as Windows CE or Linux, staying up-to-date is crucial since Microsoft and the Linux community regularly add new and better versions of the core kernel. By offloading that responsibility to the operating system and Board Support Package (BSP) provider, the customer can concentrate on the specifics of his product.

In addition to these standard products, customer-specific design services such as specification reviews and initial design reviews can help developers to get to their job done more quickly. As an additional puzzle piece for getting a new technology introduced in a development organization, Digi finds it helpful to co-develop an initial prototype together with a customer. The advantages for such an approach are multiple. This allows the engineering knowledge of Digi's support team to be drawn upon, where the support maintenance and future development of derivatives will be handled by the internal development team.

A prototype development project usually consists of:

1. Creating the initial hardware specification
2. Initial schematic design
3. Parts Placement and layout
4. Design Review
5. Prototype manufacturing

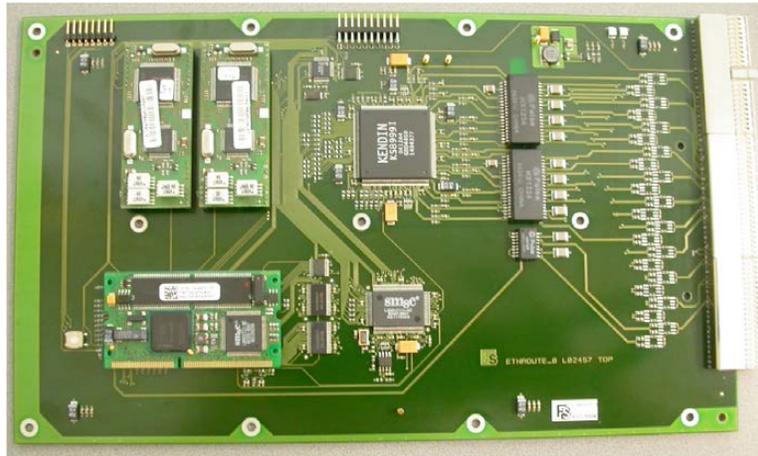
Digi can provide the pieces of the development cycle that the customer requires. A design department that has plenty of capacity might only use specification support and design review. This knowledge transfer enables the first version to be very near the final product, without a lot of redesign cycles. In other cases, the complete cycle can be outsourced when there is no internal capacity to get a new product design done in the required timeframe.



Example of a prototype printer controller board designed by Digi, based on the ConnectCore™ 9P module. It includes a complete Microsoft Windows CE 5.0 BSP with Compact Flash, USB, audio and Bluetooth device driver support.

These services are usually complemented by having support for the initial device bring-up. This can be a big advantage, since an engineer who has experience in that type of work already knows the tools, as well as the caveats and traps that can cause problems for even a skilled engineer.

Equally needed are low level software services or firmware development. This starts with the Bootloader and the mechanism for updating and managing systems in the field. It also includes the low level device drivers, where there is support needed for displays, audio, USB, touch, Ethernet and wireless infrastructure and mass storage support including NAND Flash. These low level device drivers need to be configured or adapted to the special customer needs. They are also different for every OS and need different support for either Linux or Windows CE. Especially in the RTOS area, those devices will also need to be handled based on the requirements of the underlying RTOS.



This board is designed to provide Internet access via satellite in corporate jets. It is based on a module similar to the ConnectCore XP XScale®-based module, and includes two ISDN modems for communication. Digi delivered this board, with Linux support and a Linux-based satellite simulator for testing and development, 12 weeks after receiving the order.

With the introduction of standard operating services, the big group of middleware applications such as SMTP, Java and XML also mean that these tools need to be configured, integrated and managed properly.

With the massive increase of complexity in these areas, training on how to use these features and how to quickly start the development effort in such an environment is crucial. Digi offers installation training on Linux and Windows CE, and can also provide some training for a quick project start-up.

Benefits of Working with Digi Custom Design

Digi Custom Design customers will not only gain a faster time to market, but will also increase their overall capacity – making a dramatic and fundamental change to their development approach. By focusing the internal development effort on application development – where it adds value directly to the product – the product’s chance of success at introduction is greatly increased.

This, coupled with the fact that outsourced services have a better cost estimate upfront, leads to less risk and much better budget control. It is also very likely that a good partnership with a solid supplier leads to reduced total cost, as the cost for maintaining the basic framework is distributed to more users. The total risk will be lower and the resulting stability is typically higher, as the same code base is used in more applications.

Summary

Using operating systems such as Real-Time Operating System (RTOS), Linux or Windows CE as a building block for embedded product development can simplify the process in many regards. Yet it also requires developers to spend time on low level infrastructure development, adapting the operating system for their specific applications and keeping up-to-date on new kernel releases.

Digi Custom Design offers an economical single source for embedded hardware and software assistance that reduces a product’s time to market and allows in-house developers to concentrate on embedded application development and unique product features. By leveraging Digi’s existing product expertise, a product’s overall development time will be reduced, resulting in a faster time to market.

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