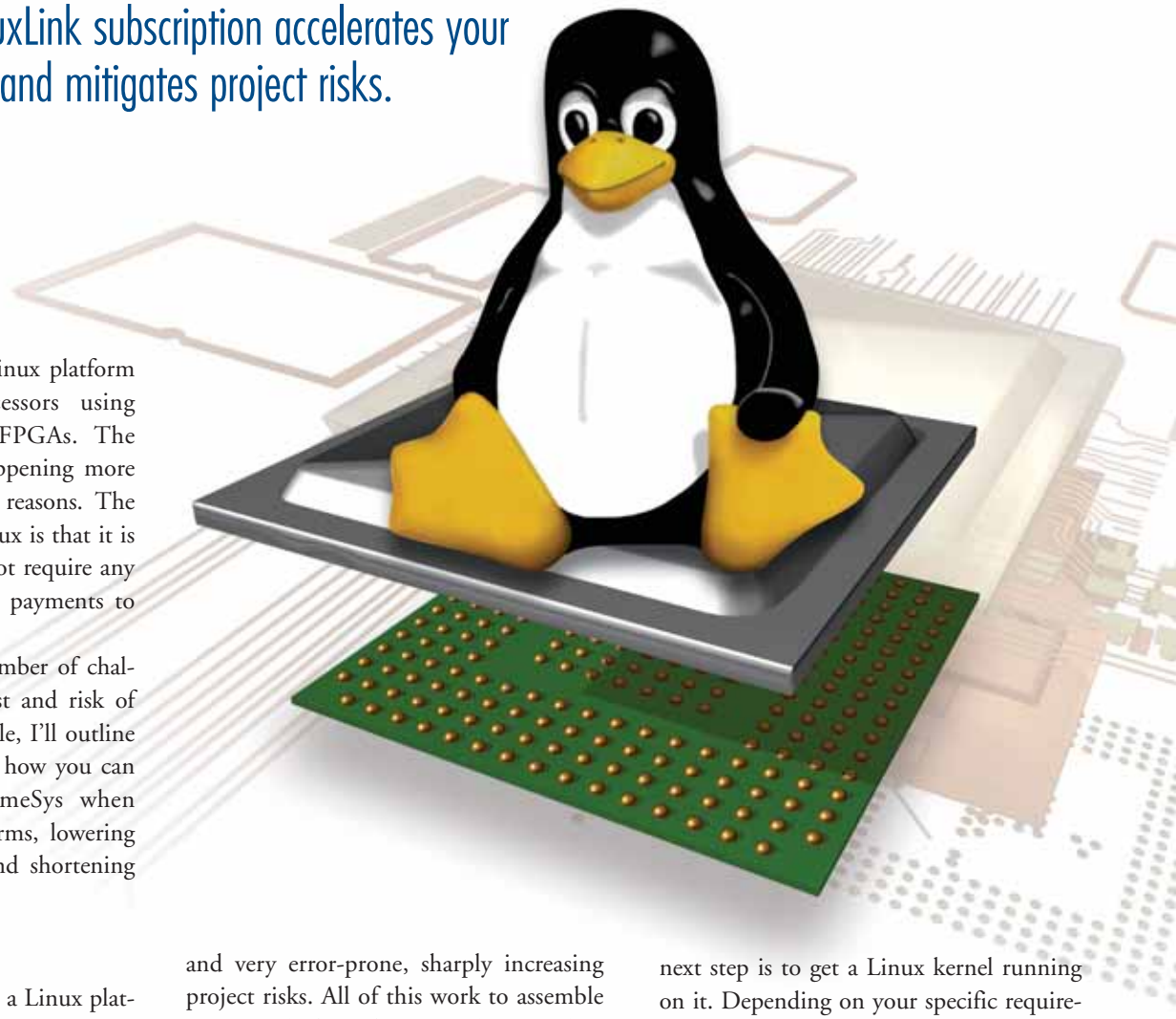
Building Linux Platforms on Xilinx Processors with LinuxLink

Find out how a LinuxLink subscription accelerates your Linux development and mitigates project risks.



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Many of you have built a Linux platform on top of Xilinx® processors using PowerPC-based Virtex™ FPGAs. The decision to use Linux is happening more often, and for a variety of reasons. The most appealing aspect of Linux is that it is free to end users and does not require any royalties or run-time license payments to an OS vendor.

There are, however, a number of challenges that drive up the cost and risk of adopting Linux. In this article, I'll outline those challenges and discuss how you can leverage LinuxLink by TimeSys when developing on Xilinx platforms, lowering your cost, risk of failure, and shortening the project timeframe.

The Challenge

Many of you choose to build a Linux platform on your own, spending substantial amounts of time "hunting and gathering" the right Linux components for your project, irrespective of your experience level.

Assuming that you are successful in gathering the right components, the next challenge lies in the aggregation and cross-compilation of all of these pieces. Unfortunately, this aggregation process can be complicated, particularly in an embedded environment where Linux components need to work with an embedded processor. This process is unpredictable and very error-prone, sharply increasing project risks. All of this work to assemble a Linux platform for an application does not add real value to the project. The value comes from applications built on top of the Linux platform.

What is My Task?

There are probably several answers to this question. At a high level, most of you want to build a Linux platform that works on custom hardware, with a value-added application on top (see Figure 1).

The hardware design is central to the project; once such a design is in place, the next step is to get a Linux kernel running on it. Depending on your specific requirements, you must change the Linux kernel to match the hardware design. Sometimes you have to develop new device drivers. This task is supported today to some degree by Xilinx EDK tools.

The next task is to assemble a root filesystem that includes the functionality required by the end application running on your custom hardware design. Assembling a root filesystem can be a very involved and time-consuming process that grows in time and risk level with the number of packages that you need to include.

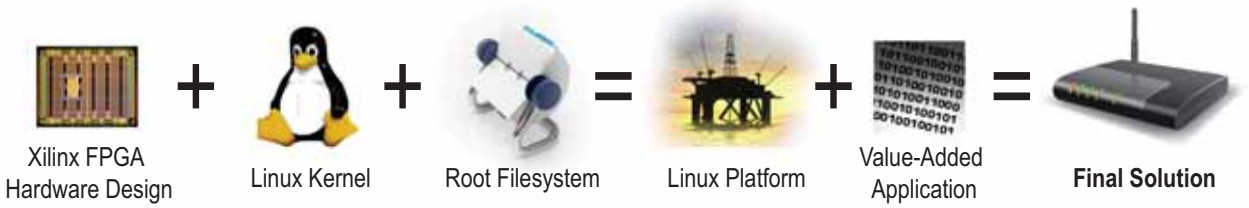

Figure 1 – Linux project components

Once a Linux kernel and a root filesystem are running on the custom hardware, you can focus on developing value-added applications. If the application requirements are well understood before the project begins, this stage of the project ends here, with aggregation of all Linux pieces into deployable images.

However, application requirements often change during the project cycle. But for Linux, this means not only application changes but also root filesystem changes. Sometimes even the Linux kernel has to be adjusted.

What Do I Need?

You will need several components to develop an embedded software platform (see Figure 2).

For any Linux-based project, Linux components are developed and/or adopted from already existing sources (open-source projects). Depending on the specific application and how complex the hardware design is, the Linux platform development process can take anywhere from weeks to months, even though there are tools and information online that you can leverage in the process. Tools, libraries, and various utilities are definitely needed to develop, debug, and test the Linux solution throughout entire project cycle.

To accelerate development processes while minimizing the risk of failure, you can use highly integrated development tools and prebuilt Linux components from a trusted source.

Development tools that run on the host development platform, combined with your experience and knowledge, will greatly drive how much time and effort you spend on a project.

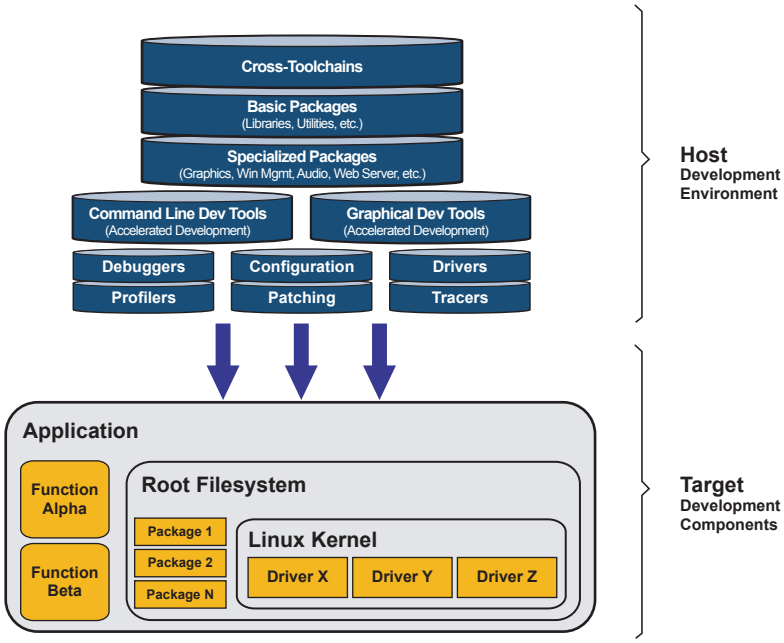

Figure 2 – Host and target components needed in a Linux project

Linux Development Process

The Linux project development cycle, as shown in Figure 3, can be divided into several stages. Some of the tasks in the cycle (stages 3 and 4) are executed in parallel; others are sequential (stages 5 and 6).

The process of developing Linux-based systems on a Virtex platform starts at the hardware level, when you select a set of hardware blocks (IPs) needed to support your application. Part of the reason why FPGAs are so popular is the flexibility they offer in assembling the hardware platform. That flexibility translates directly into how LinuxLink supports you in your efforts in getting a Linux solution in place – in a timely fashion and with minimal risk.

Linux Kernel Choice

The Linux kernel code is just like other software: it evolves to meet the needs of new designs and applications. Each kernel release, occurring on average three to four times a year, introduces new updates, fixes, and support for ever-growing sets of drivers. For this reason alone, the latest version of the Linux kernel is the preferred choice for many Linux projects.

Root Filesystem Challenges

The number of open-source projects that provide filesystem functionality grows every day, providing you with access to hundreds of Linux components that you can adopt in your project. This is both good and bad for the embedded Linux application. The wide selection of Linux components available from the open-source community provides platform support for all kinds of applications.

On the negative side, that same breadth causes headaches, as it is very difficult to

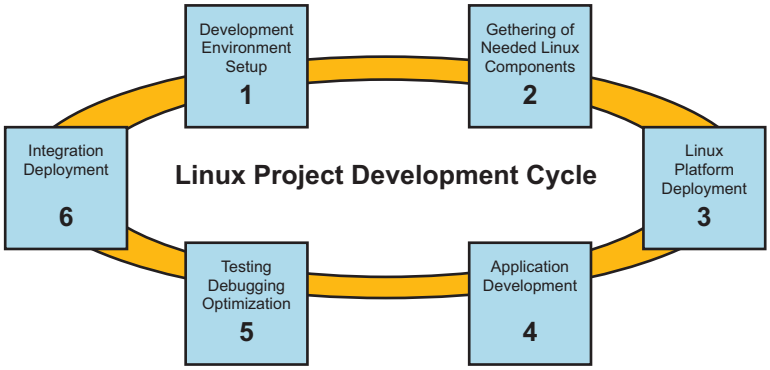

Figure 3 – Tasks in the Linux project development cycle

find the packages that work as expected or packages that work well together.

It can take a lot of time and effort to find a good set of packages, libraries, and utilities that properly support application-level development. Certainly there are some starting points available in the open-source community, but they all bear the same challenge – they are not easy to customize for speed, functionality, and the footprint required by the final deployment image.

The process of building a Linux platform based on open-source information and components is not a problem for a very knowledgeable engineer, although it still bears a high risk of failure.

How LinuxLink Accelerates Development

LinuxLink is a subscription-based system that provides embedded engineers with online access to hundreds of Linux components optimized for the Virtex platform, all of which have been tested to work with each other.

The subscription provides you with access to preassembled reference distributions optimized for different applications that include the following:

- EDK studio project files for specific hardware configurations
- Binary Linux kernel
- Cross-toolchain with platform libraries
- Development-ready root filesystem
- Sources

Linux components available through LinuxLink are regularly updated, providing you with the latest code available for both Linux kernel and platform packages.

The reference distribution is optimized to achieve two distinctive goals:

1. Setup the platform and application development environment for the target Virtex platform on your host machine
2. Get the Linux kernel up and running in matter of minutes on a Xilinx reference board (such as the ML405)

After installation of the reference distribution, you can develop, in parallel, both value-added applications and the software platform on which that application will execute (blocks 3 and 4 in Figure 3).

You can easily assemble the Linux platform with pre-built, ready-to-use packages like "alsa" sound libraries or video codecs. You can immediately download these ready-to-use packages to the host development system with the command line or Eclipse-based TimeStorm tools, where they can be aggregated into a complete and functional root filesystem. These filesystems are ready for deployment in a variety of media, including on-board NAND flash or Compact Flash cards.

Application development is well supported by the same command line and graphical development tools used for platform development. The set of architecture-specific cross-toolchains provided with a LinuxLink subscription come preinstalled with the libraries frequently needed for application development. This makes your task of building value-adding applications seamless. Development environment setup by LinuxLink is always kept in sync with target binaries. Libraries that are available on the host for application development are also available in the form of ready-to-deploy, on-target packages for the platform design.

Finally, a LinuxLink subscription provides access to tools that are indispensible in the development of an embedded Linux solution. You can download tools from the LinuxLink site such as debuggers for both system and application-level debugging, profilers for code optimizations, and tracing tools. The subscription comes with ticket-based engineering support staffed with embedded engineers with years of experience.

With a LinuxLink subscription, you get help throughout the entire development cycle (Figure 3). This means that you can get your job done much faster and in a more controlled environment.

Conclusion

LinuxLink is designed to support you as you assemble a custom Linux platform. With prebuilt, ready-to-run Linux components and support, you need not spend valuable time building out a commoditized open-source platform. You can instead focus on the development of value-added applications, along with integration, testing, and optimization. You can then introduce products to the market much faster, at higher quality and lower cost.

LinuxLink supports Virtex-4 and Virtex-5 FPGAs with the latest Linux kernels. With a LinuxLink subscription, you can choose from the latest continuously updated Linux components for your Xilinx FPGA, including the newest Linux kernel and other Linux component versions.

To find out more about how you can use the software, tools, and support provided with a LinuxLink subscription to accelerate your next embedded Linux project, visit *www.timesys.com*. You can browse the content of the LinuxLink repository to see everything available to subscribers.