WHITE PAPER

Henry Wiechman,
Software Product Management, Embedded Processing

Kevin Chalmers,
Director, Linux™ Core Product Development

Chase Maupin,
Integration team manager, Linux Core Product Development

Texas Instruments

TEXAS INSTRUMENTS

Mainline Linux™ ensures stability and innovation

Executive summary

In today's fast-paced and hyper-competitive electronics markets, software developers must focus the majority of their time on delivering that next-generation innovative functionality that will set their products apart from the competition and less time on commodity software. These engaging and creative features can mean the difference between success and failure in a new product introduction. Enabling and empowering the rapid development of new functionality starts at the foundational level of the system's software environment – that is, at the level of the Linux™ kernel – and builds upward from there.

Unfortunately, having a robust, stable, high-quality and up-to-date kernel on which to base software development sometimes can be as time consuming as actually developing new functionality. Often, software development groups must spend a considerable amount of time evaluating, tracking and implementing kernel updates, maintaining and supporting code patches, stress testing new kernel additions and other activities which distract programmers from innovative feature development and put market releases at risk.

(continued)

TI has removed many of these distractions by adopting a policy for incorporating recent stable kernels provided by the kernel.org open source community into the software development kits (SDKs) that support the rapid development of new functionality on TI's major ARM®-based embedded processors, including the Sitara™ processors and those based on the KeyStone™ architecture.

Keeping up with the kernel

Because of the constantly evolving nature of open source projects, developers are often faced with a dilemma regarding when to upgrade the underlying Linux kernel to a more recent version. Determining the appropriateness of a migration to a new version of the kernel often includes a cost/benefit analysis. The new features, functionality, and bug fixes incorporated into a kernel must first be identified, defined and described. In addition, the value, if any, associated with each new feature must be determined and quantified. The value of the benefits of the new kernel must be carefully weighed against the costs of the migration. When locking onto an older kernel for a significant period of time, the costs incurred during a kernel migration can include resolving a large number of implementation issues. For example, a bug fix at a certain point in a new version of the kernel can affect other sections of the product's code base. Sometimes these effects are unexpected and can require considerable time and effort to overcome. A common example of this would be the need to migrate to new common frameworks that have been developed in the mainline kernel which could render a code base obsolete. Moreover, a code base may contain a number of work-arounds or patches for known bugs or feature gaps. Some patches may no longer be needed with the new kernel. However, the remaining patches must be moved with the code base into the new kernel. This can involve a laborious effort of tracking and evaluating each and every patch to determine whether it is still needed or can be discarded. In addition, if the patch is discarded, consideration must be given to any potential ramifications throughout the software environment. A large number of changes during a migration can make maintaining continuity in the code base difficult while trying to leverage the development investment previously made in the code. Through the use of mainline development methods TI is looking to reduce such costs of migrations and help users more easily take advantage of the benefits of the new kernel.

Maintaining focus

The decision to migrate to a new kernel is never trivial because the mission-critical role of a development group is to provide new and innovative features and functionality that will make products competitive in the marketplace. With this goal in mind, a stable, robust and high-quality operating system environment is a fundamental requirement.

TI's support of the mainline Linux kernel ensures an efficient development environment and avoids much of the disruption and distraction that can accompany a migration to a new kernel. TI provides evaluative and analytical information on the supported kernels to facilitate effective user decision making and to enable orderly migrations when necessary. All primary TI ARM-based embedded processors in the future will support the same mainline Linux kernel, simplifying the conversion of product code bases from one kernel environment to the next and across a system manufacturer's different product lines. Users will not need to worry about features disappearing or not being migrated from one kernel version to another as their presence in mainline ensures a smooth transition between kernel versions. Users will be able to focus on their differentiating features and not worry about the foundation on which they are based.

For a number of years, TI has been an ardent supporter of the open source community and, specifically, the **kernel.org** community organization. When new versions of the kernel were made available, the various product groups within TI would base their solutions on particular versions of the kernel. Today new features and functionality as well as TI's bug fixes are provided to the kernel.org community so these improvements can be incorporated into mainline Linux. In turn, TI has committed to fully evaluate, and thoroughly document, test and productize software development kits (SDKs) utilizing mainline Linux kernels for its major processors.

Through this process, users of TI technology will be able to take full advantage of support for the latest devices, new features and bug fixes in new versions of the kernel. And, these improvements will be made available at regular intervals so that over time developers will benefit from the incremental growth in stability, robustness and quality of the mainline Linux kernel. Such an environment offers the kind of continuity and continuance that simplifies user migrations from one kernel to a newer release. Because of the compatibilities inherent in each version of mainline Linux, users will not have to worry about whether features and functionality in their code base will transfer to the next version of the kernel. TI will cooperate and collaborate with the maintainers at kernel.org who perform stringent code reviews and analyses to ensure the long-term quality and continuity of mainline Linux. Before any new code is incorporated into a new kernel, the code itself and the ramifications it might have for the rest of the operating environment are constantly and exhaustively evaluated by the organization. See Figure 1 on the following page.

For its part, TI has committed to analyzing new versions of the kernel and thoroughly documenting the additions and changes to the kernel. For those versions of the mainline Linux kernel provided to its users, TI will compile easy-to-read change logs and well documented release notes so users can quickly decide when a migration is warranted. In addition, TI will perform comprehensive stress tests on new kernels, applying a wide range of use cases and application requirements to ensure the quality, stability and robustness of the development environment supported by TI devices. Advanced users will also be able to take the Linux kernel directly from kernel.org to gain access to new features or critical fixes ahead of TI releases.

Mainline helps increase quality and robustness

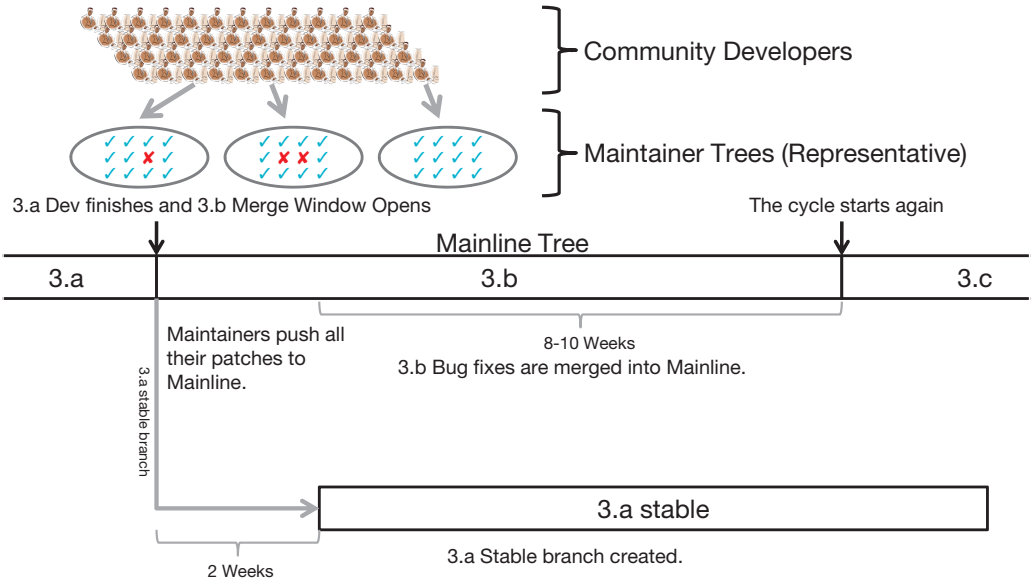

Figure 1: TI and other developers contribute to kernel.org to increase the quality and robustness of mainline Linux

Supporting mainline Linux

TI will support mainline Linux and distribute it to users through the SDKs that complement key TI ARM-based embedded processors, including the Sitara™ processors and others based on the KeyStone™ architecture. In addition to supporting stable mainline kernels, TI's SDKs also include a number of tools and capabilities which accelerate code development, such as application examples, boot loaders, various software libraries, training resources and well-researched documentation.

The SDK can be downloaded directly from **www.ti.com/sitaralinux**. See Figure 2 below.

The SDKs will be based on stable versions of the mainline Linux kernel. TI has committed to investing in enhancements to mainline Linux and collaborating with kernel.org with the intent of supporting the "long-

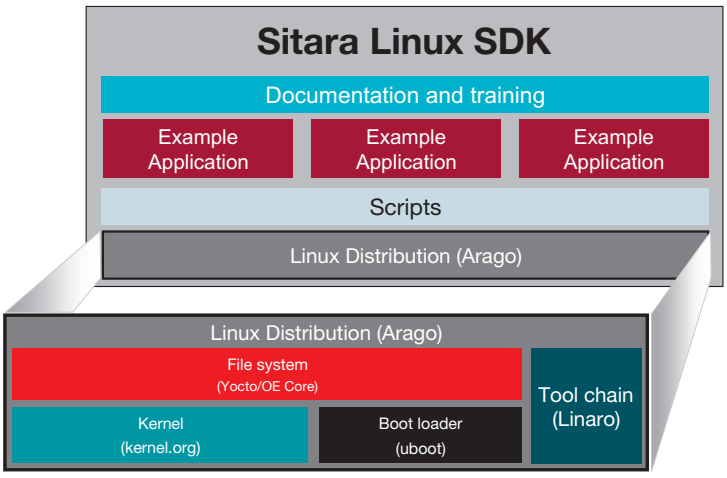

Figure 2: TI's Sitara™ Linux™ SDK and Arago Linux distribution

term stable" (LTS) version of the kernel following this designation by kernel.org. LTS is that version of the kernel which kernel.org has committed to supporting for a period of two years in order to cover a typical product life cycle while providing a common place to share both security and bug fixes. The kernel version currently available in the SDK will act as a stepping stone to the eventual implementation of the LTS version. The Sitara Linux SDK based on the 2014 LTS kernel is expected to be available from TI during the fourth quarter of 2014.

Currently, the Sitara AM335x processors are supported by the Sitara Linux SDK 7.0. Future TI devices with Linux software support, including TI's Sitara AM4x and AM5x processors as well as TI's KeyStone multicore K2Hx system-on-chips, will be maintained through a single kernel so users can capitalize on the benefits of an LTS kernel across the major TI processor portfolios.

For more information

For more information on TI's support for:

Mainline Linux, visit: **www.ti.com/mainline**

Sitara Linux SDK, visit: **www.ti.com/sitaralinux**

Linux support for TI devices, visit: **www.ti.com/linux**

Sitara processors, visit: **www.ti.com/lsds/ti/arm/sitara_arm_cortex_a_processor/overview.page**

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265