Linaro is an effective means for its member companies to affect improvements in base-level software for the ARM open-source community. This, of course, increases the performance and capabilities of the technologies available in the marketplace. By pooling their resources in support of Linaro, member companies are able to more favorably influence the scope, scale and nature of open-source software and make advanced capabilities available sooner for integration into ARM-based development programs. Pooling their resources for base-level software also allows member companies to focus more of their time on their differentiating software and provide those features to their customers sooner.

In fact, Linaro is able to provide ARM-focused advanced capabilities sooner than the main-tainers of the GCC tool chain and compilers, and, at the same time, push these new features upstream for inclusion in GCC releases maintained by the Free Software Foundation (FSF). As a result, ARM developers can obtain the advanced features of Linaro releases up to one year before these same features are included in GCC. This can improve significantly a development organization’s time-to-market, since advanced features often accelerate design cycles.

In addition, Linaro’s robust testing procedures minimize the destabilizing effects that new tool chain features or compiler improvements sometimes provoke. Thorough initial testing is conducted prior to Linaro releases and also on a continuing basis following every release. These ongoing testing practices lead to patches and fixes that appear in Linaro’s subsequent monthly releases of new capabilities, ensuring that Linaro-developed features are fully tested by the time they are included in the FSF’s yearly GCC release.

Linaro software is targeted at ARM’s advanced Cortex™-A processors, specifically the A5, A7, A8, A9 and A15.
maintenance version which would include fixes and patches to the previous GCC, but no new features, since these might destabilize the code generated.

Linaro’s engineers are also responsible for optimizing for the ARM community certain features and capabilities that have been included in the standard GCC tool chain. An example of this is the ARM-specific improvements Linaro has made to GCC’s AddressSanitizer (ASAN), a fast memory error detector.

The Linaro tool chain is being integrated with open-source file systems and distributions such as OpenEmbedded and Yocto Project™. As this work progresses, developers will ultimately have access to a seamless development environment that works with a variety of Linux distributions from which developers can choose, each with their own strengths and capabilities.


Because of the support it receives from across the industry, Linaro is uniquely empowered to offer engineers the best of both worlds: the open-source community and commercially available software. The fulltime on-staff developers of Linaro draw on the creativity and vibrancy of the open-source community for their inspiration. At the same time, their work conforms to a set of stringent quality standards. The result is an organization that is responsive to the needs of the ARM-based open-source community and which supports its work to the highest standards. This is evidenced by the regularity and frequency of its releases and its ability to keep pace with advancements in the ARM roadmap and issue code fixes and patches.

Much of the research and development conducted by Linaro’s engineering staff is intended to improve the code generated by its compilers. For example, auto-vectorization when using Neon intrinsics to take advantage of the power of single instruction/multiple data (SIMD) capabilities is one area of particular attention. Another area of continuing investigation involves how to improve low-level code sequences. These efforts might examine how the compiler chooses which registers to use and whether the registers that are chosen do indeed optimize code execution. Selecting some registers for certain code sequences might require excessive storing and transferring of intermediate values which would slow code execution.

Besides its ongoing development programs, Linaro’s engineers also respond to specific issues that are raised from within the community or by its members. An example of this might involve a designer at a member company who is developing a new algorithm. Unfortunately, the code output by the compiler for the new algorithm is not optimized, resulting in poor performance. Linaro’s staff engineers can examine the compiler’s processes and develop improvements to its output.
Empowering TI developers

By integrating Linaro software, tools and testing procedures into its software development kits (SDKs), TI has improved the speed and performance of its ARM Cortex-based systems and accelerated user software development.

Linaro software is targeted at ARM’s advanced Cortex-A processors, specially the A5, A7, A8, A9 and A15. Linaro’s libraries have been optimized accordingly, recognizing and taking into account all of the various aspects of the ARM architecture, the function call procedures, compatible code structures and processing methods to ensure improved performance and system throughput. TI engineers are able to leverage these capabilities in enhancing their offerings for end equipment developers. For example, TI was able to improve floating-point processing performance on ARM processors recently by migrating from a software-based methodology to a hardware-based application programming interface for floating-point processing. In other words, the performance benefits and capabilities initially enabled by Linaro software are compounded with the improvements and additional features that TI engineers are able to provide.

Currently, Linaro tools, software and testing procedures are available in TI SDKs that support a range of TI’s processors, including TI’s Sitara™ processors, OMAP™ processors and digital signal processors (DSPs):

- Linux EZ Software Development Kit (EZSDK) for Sitara processors
  - LinuxEZSDK-AM335x
  - LinuxEZSDK-AM35x
  - LinuxEZSDK-AM37x
  - LinuxEZSDK-BBXM
  - LinuxEZSDK-BONE

- SYS/BIOS™ and Linux KeyStone™ Multicore Software Development Kit (MCSDK) for multicore DSPs (BIOSLINUXMCSDK-K2)

- Linux Yocto Evaluation Software for OMAP5432 processor-based EVM (LINUX-YOCTO-EVALUATION-SW-OMAP5432-EVM)

As a result of this broad support, developers must only climb the Linaro learning curve once for one processor family, after which they can quickly transfer their newly acquired skills and expertise to other development programs based on another processor family.
Conclusions

Linaro support is just one of the many examples of TI’s longstanding commitment to the open-source community. Linaro’s tools, software components and testing procedures are important components of TI’s Linux SDKs which provide developers with a highly efficient environment for creating optimized ARM Cortex-A-based solutions.

For more information about Linaro, go to www.linaro.org.
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

<table>
<thead>
<tr>
<th>Audio</th>
<th><a href="http://www.ti.com/audio">www.ti.com/audio</a></th>
<th>Applications</th>
<th><a href="http://www.ti.com/automotive">www.ti.com/automotive</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Amplifiers</td>
<td>amplifier.ti.com</td>
<td>Automotive and Transportation</td>
<td><a href="http://www.ti.com/automotive">www.ti.com/automotive</a></td>
</tr>
<tr>
<td>Data Converters</td>
<td>dataconverter.ti.com</td>
<td>Communications and Telecom</td>
<td><a href="http://www.ti.com/communications">www.ti.com/communications</a></td>
</tr>
<tr>
<td>DSP</td>
<td>dsp.ti.com</td>
<td>Consumer Electronics</td>
<td><a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a></td>
</tr>
<tr>
<td>Interface</td>
<td>interface.ti.com</td>
<td>Industrial</td>
<td><a href="http://www.ti.com/industrial">www.ti.com/industrial</a></td>
</tr>
<tr>
<td>Logic</td>
<td>logic.ti.com</td>
<td>Medical</td>
<td><a href="http://www.ti.com/medical">www.ti.com/medical</a></td>
</tr>
<tr>
<td>Power Mgmt</td>
<td>power.ti.com</td>
<td>Security</td>
<td><a href="http://www.ti.com/security">www.ti.com/security</a></td>
</tr>
<tr>
<td>OMAP Applications Processors</td>
<td><a href="http://www.ti.com/omap">www.ti.com/omap</a></td>
<td>TI E2E Community</td>
<td>e2e.ti.com</td>
</tr>
<tr>
<td>Wireless Connectivity</td>
<td><a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated