



ACCELERATING INNOVATION FOR EMBEDDED AUTOMATION

FROM CONCEPT TO PRODUCT

The open-source Yocto Project* helps ADI Engineering and Inference customize cutting-edge embedded solutions on the aggressive timelines that today's marketplace demands.

Companies that use embedded Linux* in their products typically develop custom OSs to meet their specific needs, a complex and resource-intensive process that can drive up project time and expense requirements. That challenge is increased by the need to create custom board support packages (BSPs), based on components that are often in multiple formats and from multiple silicon vendors. The Yocto Project* streamlines the creation of custom Linux and BSPs with templates, tools, and best practices that can help companies bring products to market faster and at a lower cost.

ADI Engineering in Charlottesville, Virginia, routinely builds complex embedded computing products for its customers on schedules that might seem impossible to many companies. Working with Intel several years before a processor platform becomes publicly available, ADI creates production-ready reference platforms that it supports as "development kits," which form the foundation for upcoming generations of ADI's embedded product offerings.

In its engagements with customers, ADI provides deep customization of these reference designs as a key part of its made-to-order embedded computing strategy. The total solution is based on that hardware foundation, custom-engineered to project-specific requirements, as well as other hardware, software, and firmware components to provide comprehensive new product introduction support.

Most ADI projects include the development of BSPs. The Yocto Project helps ADI accelerate OS and BSP customization and development, enabling the company to take advantage of the latest Intel® architecture features. Because the Yocto Project delivers many of the common components used in embedded Linux systems, it allows ADI developers to focus their attention and resources higher up the software stack, introducing value-added product features, even in the face of rapidly changing project requirements.

- ☒ ADI's Open IP business model spans a variety of industries. For example, their Broadcast Optical Interconnect technology, built using Intel® Core™2 Duo processors, speeds the flow of multiple data streams in broadcast control rooms.

CHALLENGE

In just three months, develop custom, cost-optimized hardware and embedded Linux and BSPs—ready to run Java*-based, third-party building automation stacks—for use in creating a family of three fully-functional building-automation and energy management product prototypes.

SOLUTION

The Yocto Project provided a highly flexible, capable framework with working, base-functionality BSPs. This allowed for the build-out of the embedded Linux and modified BSP solution, while enabling the adoption of dynamically changing features on-the-fly in the face of rapidly evolving customer requirements.

RESULT

Through the use of the Yocto Project, ADI and its customer, Inference, completed all hardware, software, and firmware development; prototype manufacturing; board bring-up and validation; and mechanical and packaging design in a fraction of the time normally required.



A NEW BREED

OF EMBEDDED COMPUTING COMPANY

ADI specializes in offering custom, made-to-order embedded computing solutions to fulfill complex product requirements, and because ADI addresses these requirements using a robust set of reference platforms, it can build tailor-made products very rapidly. The company differentiates itself from other embedded solution makers across a range of key market segments—from machine-to-machine, networking, and communications to storage, medical, and military/aerospace—in the following ways:

- **Specialization in creating custom products** based on the latest Intel architecture-based processors, optimized to customer requirements and quickly brought to market.
- **Exceptional support** for domestic clients during the highly interactive work involved in product customization, facilitated by headquarters in the United States.
- **Production control and recurring cost reduction** from ADI's Open IP business model, which enables licensing and production of all products developed by ADI, allowing greater flexibility for customers.

ADI's long-standing collaborative relationship with Intel helps the company offer early adoption of advanced Intel® technologies to its customers. Well before Intel offers a computing platform to the public, ADI and Intel engineers often work together to create production-ready reference designs based on the new platform that showcase new silicon technologies and board-level design techniques.

Based on platforms that range from small-footprint Intel® Atom™ processors to high-end Intel® Xeon® processors, ADI reference designs can be built, sold, and supported as development kits. In addition to hardware, these ready-to-run packages typically include components such as a boot loader, OS image, software development kits, and demo versions of applications.

ADI also offers a full spectrum of new-product introduction services to customers, which may include everything from concept, design, prototype, and validation to production and volume manufacturing, as a means of accelerating time to market.

■ ADI Engineering Empowers Customers with the Flexibility of an Open Model

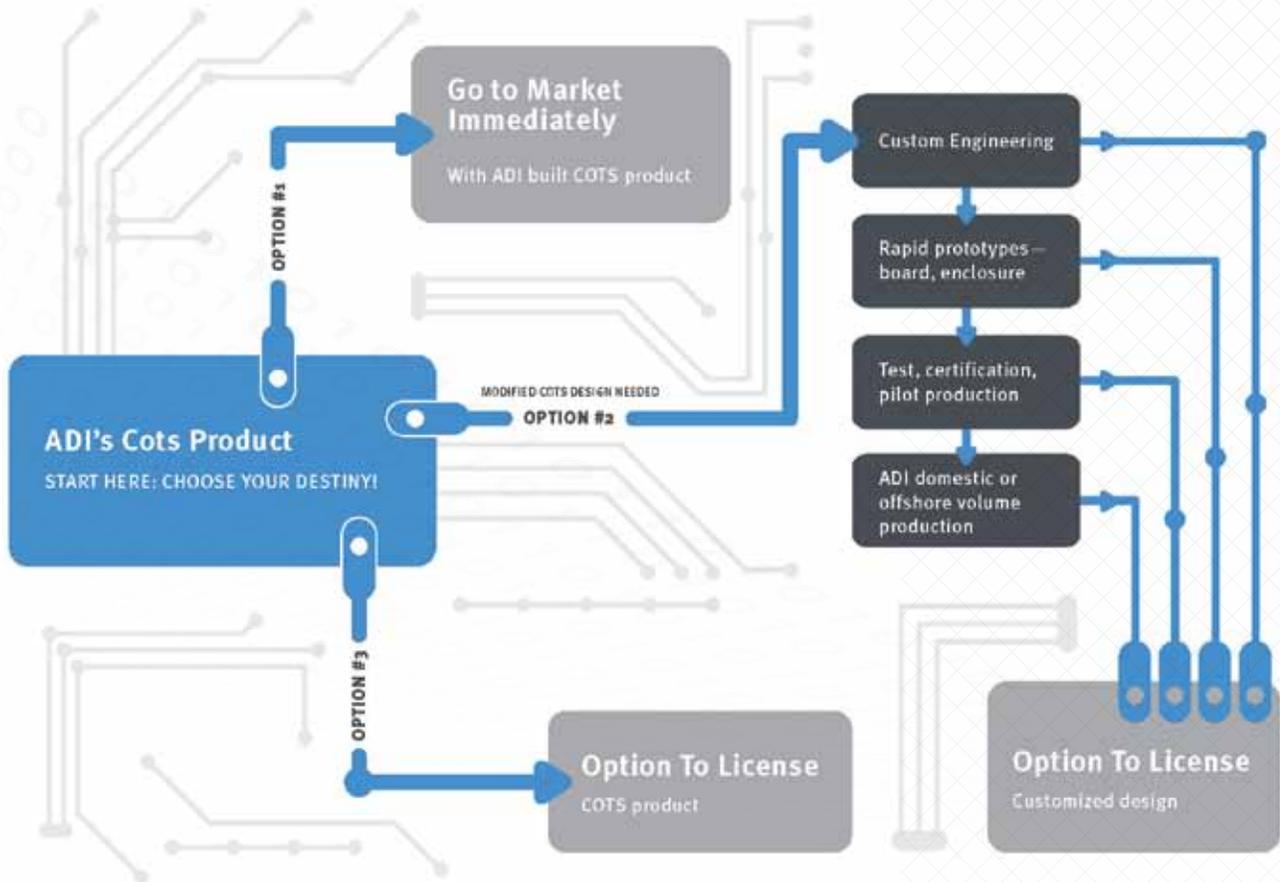
In the spirit of open source, ADI takes an open approach to licensing its solutions—an innovative framework the company refers to as "Open IP." All ADI products, including its standard products and customer-specific derivatives based on them, are available for licensing and direct customer manufacturing. By providing ADI customers the option to license and manufacture products themselves, this open framework provides a number of advantages.

- **Autonomy.** Customers are more independent of third parties, enabling direct manufacturing at their sole discretion and assuring long-life production with fewer risks.
- **Cost control.** Production expenses associated with manufacturing are substantially under the control of the customer, and the supply chain is shortened, with less margin stacking.
- **Design expertise.** Customers retain autonomy and cost control while benefiting from ADI design expertise and early-to-market technology, with little or no R&D burden.



OpenIP Bridges the “COTS GAP”

Open IP re-establishes customer control in a COTS world



Open IP allows ADI's customers to license any ADI design—including COTS single-board computers, semi-customer-modified COTS products, or fully custom designs.

RAPID PRODUCT DEVELOPMENT

FOR BUILDING AUTOMATION AND ENERGY MANAGEMENT

Early in 2012, Inference, a newly formed company in Richmond, Virginia, approached ADI and asked for the creation of a prototype of a new embedded automation product within three months as the basis for a demonstration at the Niagara Summit, a major conference for the energy, machine-to-machine, and building automation industries. This project required ADI to adapt existing Yocto Project BSPs to boot prototype hardware on Linux, while providing the underlying software requirements to support an existing software application. ADI's business model based on reference designs is well suited to projects such as this one, with aggressive timelines and demanding engineering requirements.

ADI and Inference selected ADI's Cinnamon Bay EX* reference platform, which is based on the Intel Atom processor E6xx series and Intel® Platform Controller Hub EG20T, for development of the prototype. This combination of components brought together high performance, low power consumption, integrated graphics and video capabilities, available extended-temperature parts, and a seven-year production commitment from Intel.

Project requirements evolved and feature specifications changed throughout development as Inference engineers continued to refine the product. ADI's reference platform—based on Intel® silicon, paired with development processes and templates from the Yocto Project—proved to be an excellent foundation to meet these changing needs. Functionality such as graphics support, which can be a significant stumbling block in embedded Linux development, worked flawlessly without any extra effort from the development team, and the team reports that this sort of time savings was instrumental in the project's success.

Ultimately, the team delivered three functioning prototypes of different levels of complexity in time for the Niagara Summit, each running a custom version of embedded Linux based on the Yocto Project and software based on Java and the APL programming language. The prototypes allowed for control and energy monitoring of building equipment systems using web-based applications on a smartphone, tablet, or PC. The demonstrations were well received by potential customers, and product development has moved to the next phase.



The Yocto Project* helped ADI Engineering and Inference complete the entire prototype process in just three months.

- Inference provides solutions that help people connect with, manage, and derive value from smart devices in applications ranging from building automation and energy management to machine-to-machine and security.



STREAMLINING DEVELOPMENT

WITH THE YOCTO PROJECT

Development of a solution such as the Inference product can be likened to a large and complex jigsaw puzzle. The Yocto Project provides guidance to assemble the pieces efficiently. Because Yocto Project contributors pre-develop and tune general components that are widely used, such as graphics support, product and prototype developers can focus on tasks more specific to their own products where they can add distinct value in introducing solution-specific features and functionality.

Building atop—or minimally customizing—the solid foundation provided by the Yocto Project, rather than re-creating the wheel, and focusing in areas that truly add value corresponds directly to savings in development time. And this savings helps companies reduce project budgets, accelerate time-to-market, and capture new revenue streams by addressing the needs of new customers and markets. In fact, with a timeline as aggressive as that of the Inference project, which becomes more typical with every passing

year, the Yocto Project can make success possible where project teams could otherwise fall short. Steve Yates, the president, founder, and CTO of ADI, reports that he considers the Yocto Project to be a core enabler of productivity for development teams within the company.

For all companies considering adoption of the Yocto Project for embedded Linux development, these technologies represent not only a way to enhance production efficiency, but also a significant step forward in reducing embedded Linux fragmentation. Unlike a disparate array of BSPs and tools offered from multiple providers that each require a different set of tools and processes, the Yocto Project offers an emerging level of broad industry support through collaborative strategic planning among providers of silicon, devices, OSs, and embedded boards. This approach results in a framework that is applicable across architectures and commercial OSs.

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PROJECT™

“The Yocto Project has moved well beyond its roots as an R&D effort—it’s a very robust paradigm for building custom versions of embedded Linux. It’s like a set of recipes that are simple to pick up and start using. A lot of tasks that we used to do manually are now automated, which adds a tremendous amount of efficiency.”

— Steve Yates, President, ADI Engineering



YOCTO PROJECT BENEFITS:

FAST TRACK TO A CUSTOM EMBEDDED LINUX DISTRIBUTION

Hosted by the Linux Foundation, the Yocto Project is a collaborative, open-source project that facilitates and streamlines the development of custom embedded Linux with proven templates, tools, methods, and community support.

The Yocto Project has received the backing of some of the industry's top embedded silicon makers, OS vendors, and embedded board makers. Significant project contributions by Intel help ensure pre-validation for Intel® hardware platforms, and an extensive line-up of prebuilt and tested BSPs offer solid Linux support across Intel® embedded platforms. The project provides diverse benefits:

Fostering Cross-Ecosystem Innovation

In the best spirit of open source, the Yocto Project facilitates work across the ecosystem:

- **Simplified license inclusion tracking.** Programming filters and automatic reporting on GPL license types simplifies legal compliance.
- **Cross-architecture solution.** Porting across application and device types on any hardware architecture, including x86 (32-bit and 64-bit), ARM*, PPC, and MIPS, requires only a minor configuration change for the project to automatically rebuild without additional user effort.
- **Advisory board participation.** Intel participates in the Yocto Project advisory board, which also includes ENEA, Mentor Graphics, MontaVista, Open Embedded, Texas Instruments, and Wind River.

Accelerating Product Development

The Yocto Project enables fast time-to-market for high-quality products:

- **UI framework-agnostic.** Developers have the flexibility to use their preferred UI tools, such as Clutter, QT, HTML5, Gnome, and more.
- **Economical transition to commercial OS.** In addition to supporting roll-your-own OSs, ENEA, Mentor Graphics, and Wind River offer commercial OS support and services, protecting code and design investments when moving from a proof of concept to a commercial OS.
- **Ease-of-use.** A rich graphical user interface simplifies rapid adoption and day-to-day operation.
- **Automatic device customization.** An application development toolkit is created with each image, enabling access only to the capabilities needed for a specific device or application.



Yocto Project Training Video

Interested in getting a jump-start in using the Yocto Project? Scott Garman, Embedded Linux Engineer, Intel Corporation, provides developers with a quick orientation and explains how to build an initial Linux image and run it through the emulator. <http://vimeo.com/36450321>

☒ **Yocto Project Compliance Program**

The Yocto Project Compliance Program offers businesses a means to demonstrate interoperability by registering their products and components as Compatible, while companies can denote their alignment with the goals and directions of the Yocto Project by registering as a Participant.



"The Yocto Project provides an opportunity to help Intel customers differentiate and create unique solutions in the embedded market segment. Intel remains committed to choice in operating systems and our Intelligent Systems roadmap for embedded views the Yocto Project as a way to provide our customers with a flexible Linux enabling vehicle."

- Ton Steenman, Vice President and General Manager, Intelligent Systems Group, Intel

Test drive the Yocto Project to streamline custom embedded Linux development:

www.yoctoproject.org



Learn more about open source at Intel, the Yocto Project, ADI Engineering, and Inference:

www.intel.com/opensource/yoctoproject

www.adiengineering.com

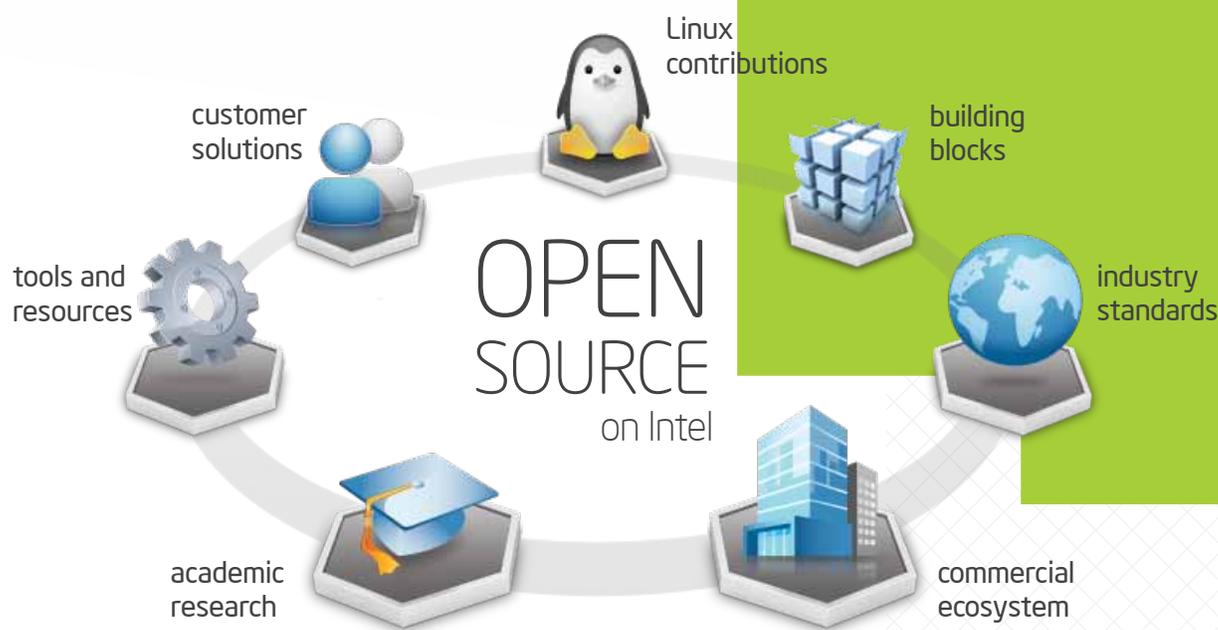
www.inference.com



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