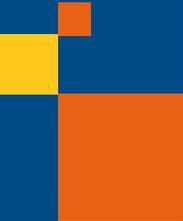


# Read Me First!

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intel<sup>®</sup>

# Using this Document

## New to Intel® FPGAs? This guide will help you with:



[Getting Started](#): Get your My Intel account for access to information and support



[Preparation](#): Download the Intel Quartus® software and get software licensing setup



[Software Developers](#): Resources for embedded and software application developers focusing on a C / C++ flow



[Hardware Developers](#): Resources for FPGA developers focusing on system level, HDL, and schematic design entry

# Using this Document (cont.)

## New to Intel® FPGAs? This guide will help you with:



[Research](#): See design examples, solutions, literature, or intellectual property (IP) for your project



[Support](#): Learn about the varieties of websites and training material to keep you productive on your design



[Design Resources](#): Successfully complete and optimize your design

But First....

# Intel® FPGA Support Resources

- <https://www.intel.com/content/www/us/en/support/programmable/support-resources/overview.html>

# Agenda



Getting Started



Preparation



Software Developers



Hardware Developers



Research



Support



Design Resources

# How to Create a My Intel Account



- From Intel® home page
- Click Sign up here

A screenshot of the Intel website's user interface. The top navigation bar includes the Intel logo, menu items for PRODUCTS, SUPPORT, SOLUTIONS, DEVELOPERS, and PARTNERS, a user profile icon circled in red, a globe icon for USA (ENGLISH), and a search bar labeled 'Search Intel.com'. Below the navigation bar, the 'Sign In' section features input fields for 'Username' and 'Password', a 'Sign In' button, and a 'Remember me' checkbox. To the right, a message states 'Don't have an Intel account? [Sign up here](#) for a basic account.', with the 'Sign up here' link highlighted by a red rectangle and a mouse cursor pointing to it. Additional links for 'Terms of Service', 'Forgot your Intel username or password?', and 'Frequently Asked Questions' are also visible.

# Account Registration



- Basic account registration
- Provide registration information
- Registration complete!

The screenshot shows the Intel website's registration page for a Basic Intel Account. The page has a blue header with the Intel logo and navigation links: PRODUCTS, SUPPORT, SOLUTIONS, DEVELOPERS, PARTNERS. On the right side of the header, there are icons for user profile and language selection (USA (ENGLISH)).

The main content area is titled "Register for Basic Intel® Account" and includes a sub-header "Personal Information". Below this, there are several input fields:

- First Name (text input)
- Last Name (text input)
- Business Email Address (text input)
- Username (text input)
- Password (text input)
- Confirm Password (text input)
- Country/Region (dropdown menu)
- Profession (dropdown menu)
- Country/Region Code (dropdown menu)
- Phone (text input)
- Extension (optional) (text input)

A "Next Step" button is located at the bottom right of the form.

- <https://www.intel.com/content/www/us/en/forms/basic-intel-registration.html>

# Premier Account

- <https://www.intel.com/content/www/us/en/forms/developer/premier-registration.html>

The screenshot shows the Intel Developer Zone Premier Account registration page. The page has a blue header with the Intel logo and navigation links: PRODUCTS, SUPPORT, SOLUTIONS, DEVELOPERS, PARTNERS. There is also a user icon, a globe icon for language selection (USA (ENGLISH)), and a search bar labeled 'Search Intel.com'.

### Register for a Developer Zone Premier Account

Request access to Intel confidential content, pre-release information on upcoming products, advanced design tools, and support services to help with your project. **A standard Corporate Non-Disclosure Agreement (CNDA) is required.** If your company already has a CNDA with Intel, access will be granted within 3 days. Upon review of your application, if it is determined that a CNDA does not exist, an account manager will contact you directly.

If you do not wish to create a CNDA with Intel, you may create a [Standard Account](#) to access Intel support communities, public documentation, and online tools.

All fields are required except any fields specifically marked as optional.

---

### Contact Information

First Name <small>(required)</small>	Last Name	
Business Email Address	Username	
Create Password <small>(required)</small>	Confirm Password <small>(required)</small>	
Job Title		
Select Profession <small>(required)</small>	Country/Region <small>(required)</small>	
Country/Region Code <small>(required)</small>	Business Phone	Extension (optional)

#### Need Help?

[Chat Support](#)

North America:  
Dial 1-800-538-3373

Other continents:  
Dial [AT&T Access Code](#)  
wait for tone,  
1-800-538-3373

24-hour support Monday-Friday  
(U.S. Pacific Time)

# What You Get with Registration



## You get access to the following

The screenshot shows the Intel website's user dashboard. At the top, there is a navigation bar with the Intel logo on the left and menu items: PRODUCTS, SUPPORT, SOLUTIONS, DEVELOPERS, and PARTNERS. On the right side of the navigation bar, there is a user profile icon, a globe icon labeled 'USA (ENGLISH)', and a search bar labeled 'Search Intel.com'. Below the navigation bar, the dashboard is divided into two main sections: 'My Intel Dashboard' and 'My Tools'. The 'My Intel Dashboard' section includes links for Inbox, Support, Content, Training, Events, Community, Inbox Settings, Profile, Programs, and Settings, Subscription Preferences, and Frequently Asked Questions. At the bottom of this section is a blue 'Sign Out' button. The 'My Tools' section is divided into two columns of links. The first column includes Product Specifications (ARK): CARE Extension, Resource & Documentation Center, Secure Content File Transfer, Customer Notifications Subscription, and Digital Power Configurator Download. The second column includes Intel® FPGA Design Software Download Center, Intel® FPGA Self Service Licensing Center, Intel® FPGA Training, Intel® FPGA University Program, and Product Roadmaps. Each link in the 'My Tools' section has a small question mark icon next to it.

# Subscription Preferences



- Click on the Customer Notifications Subscription

The screenshot shows the Intel website's navigation menu. The Intel logo is on the left. The main navigation bar includes links for PRODUCTS, SUPPORT, SOLUTIONS, DEVELOPERS, and PARTNERS. On the right, there is a user profile icon, a globe icon for USA (ENGLISH), and a search bar labeled "Search Intel.com". Below the navigation bar, the "My Intel Dashboard" section lists links for Inbox, Support, Content, Training, Events, Community, Inbox Settings, Profile, Programs, and Settings, Subscription Preferences, and Frequently Asked Questions. A "Sign Out" button is at the bottom left. The "My Tools" section lists various tools, with "Customer Notifications Subscription" highlighted by a red box.

My Intel Dashboard	My Tools
<a href="#">Inbox</a>	<a href="#">Product Specifications (ARK): CARE Extension</a>
<a href="#">Support</a>	<a href="#">Resource &amp; Documentation Center</a>
<a href="#">Content</a>	<a href="#">Secure Content File Transfer</a>
<a href="#">Training</a>	<a href="#">Customer Notifications Subscription</a>
<a href="#">Events</a>	<a href="#">Digital Power Configurator Download</a>
<a href="#">Community</a>	<a href="#">Intel® FPGA Design Software Download Center</a>
<a href="#">Inbox Settings</a>	<a href="#">Intel® FPGA Self Service Licensing Center</a>
<a href="#">Profile, Programs, and Settings</a>	<a href="#">Intel® FPGA Training</a>
<a href="#">Subscription Preferences</a>	<a href="#">Intel® FPGA University Program</a>
<a href="#">Frequently Asked Questions</a>	<a href="#">Product Roadmaps</a>

# Subscription Preferences



- Select
  - Document type
  - Frequency
  - Delivery location

The screenshot shows the Intel My Intel Dashboard with the 'Inbox Settings' page open. The page header includes the Intel logo, navigation links for PRODUCTS, SUPPORT, SOLUTIONS, DEVELOPERS, and PARTNERS, a user profile icon, a globe icon for 'USA (ENGLISH)', and a search bar for 'Search Intel.com'. Below the header, the breadcrumb 'My Intel Dashboard / Inbox Settings' is visible. The main content area is titled 'Inbox Settings' and contains a form with the instruction: 'Tell us which delivery mode and frequency you prefer for different types of messages:'. The form is a table with columns for 'Content Notifications', 'Inbox', 'Email', and 'Frequency'. It lists several notification types, each with checkboxes for 'Inbox' and 'Email', and a dropdown menu for 'Frequency' (all set to 'Immediately'). At the bottom right of the form are 'Confirm' and 'Cancel' buttons.

Content Notifications	Inbox	Email	Frequency
My Library: Revised Bookmark	<input type="checkbox"/>	<input type="checkbox"/>	Immediately ▾
File Transfer: Intel Transfer	<input type="checkbox"/>	<input type="checkbox"/>	Immediately ▾
Restricted Documents: Recall	<input type="checkbox"/>	<input type="checkbox"/>	Immediately ▾
Restricted Documents: Inactivation	<input type="checkbox"/>	<input type="checkbox"/>	Immediately ▾
Restricted Documents: Approval	<input type="checkbox"/>	<input type="checkbox"/>	Immediately ▾
Site: Broadcast	<input type="checkbox"/>	<input type="checkbox"/>	Immediately ▾

# Agenda



Getting Started



Preparation



Software Developers



Hardware Developers



Research



Support



Design Resources

# Preparation

- Software download
- Getting a license



# Download Software



Download the latest design software and tools at the Download Center

- <https://www.intel.com/content/www/us/en/collections/products/fpga/software/downloads.html>

The screenshot shows the Intel FPGA Software Download Center page. At the top, there is a navigation bar with the Intel logo and links for PRODUCTS, SUPPORT, SOLUTIONS, DEVELOPERS, and PARTNERS. A search bar is on the right. Below the navigation bar, the page title is "FPGA Software Download Center". The main heading is "Intel® Quartus® Prime Pro Edition Design Software Version 22.1 for Windows". Below the heading is a table with columns for ID, Date, and Version. The table contains one row with ID 727907, Date 5/4/2022, and Version 22.1 (Latest). Below the table, there is a paragraph of text about functional and security updates. Another paragraph discusses removal from the web when support for all devices is available in a newer version. A third paragraph mentions the need to upgrade to the latest license daemon software (v11.18.2.0). Below that, there are links for "Critical Issues and Patches for the Intel® Quartus® Prime Pro Edition Software, Version 22.1", "Knowledge Base: Search for Errata", and "Problems and Answers on specific IP or Products". At the bottom, there is a "Downloads" section with a horizontal menu containing "Complete Download", "Multiple Download", "Individual Files", "Additional Software", and "Copyright Licensed Source".

ID	Date	Version
727907	5/4/2022	22.1 (Latest)

# Get a License



## Visit the Intel® FPGA Licensing Support Center

- <https://www.intel.com/content/www/us/en/support/programmable/licensing/support-center.html>

intel PRODUCTS SUPPORT SOLUTIONS DEVELOPERS PARTNERS USA (ENGLISH) Search Intel.com

Intel® FPGA Licensing Support Center

# Intel® FPGA Licensing Support Center

1. License Key Required? 2. License Generation 3. License Setup 4. Debugging

# Licensing Support Center Tasks



1. Which software needs a license key
2. Generate the license
3. License setup
4. Debugging license issues

# 1. License Key Required?



## 1. License Key Required?

The following table details the license requirements for various Intel® FPGA software tools and IP cores.

Software / IP	License Key Required?	License Fee Required?
Intel® Quartus® Prime Pro Edition	Yes	Yes Note: Intel Quartus Prime Pro Edition software seat licenses include licenses for the Intel Quartus Prime Standard Edition software. <a href="#">Compare between Editions</a>
Intel Quartus Prime Standard Edition	Yes	Yes
Intel Quartus Prime Lite Edition	No	Beginning with version 8.1, a license file is no longer required for this or future versions of the Intel® Quartus® II Web Edition or Intel Quartus Prime Lite Edition software. There is no charge for this version of the software.

# 2. License Generation



## 2. License Generation

### How to Activate and Generate the License File?

License	How to Activate and Generate the License File?
Intel Quartus Prime Pro Edition	<a href="#">Intel® FPGA Self Service Licensing Center</a>
Intel Quartus Prime Standard Edition	<a href="#">Intel® FPGA Self Service Licensing Center</a>
Intel Quartus Prime Lite Edition or Intel Quartus II Web Edition Licensing	Get a license for previous versions (prior to version 8.1) of the <a href="#">Intel Quartus II Web Edition software</a> . Beginning with version 8.1, a license file is no longer required for this or future versions of the Intel Quartus II Web Edition or Intel Quartus Prime Lite Edition software.
ModelSim*-Intel® FPGA Edition	<a href="#">Intel® FPGA Self Service Licensing Center</a>

# 3. License Setup



## 3. License Setup

### Intel Quartus Prime Standard and Pro Edition

- [Setting Up Fixed Node License \(HTML | PDF\)](#)
- [Setting Up Floating Licenses \(HTML | PDF\)](#)
- Online Training: [Setting up floating licenses.](#)

### ModelSim\*-Intel® FPGA Edition

- [Specifying the License for the ModelSim\\*-Intel® FPGA Edition Software \(HTML | PDF\)](#)

### DSP Builder for Intel® FPGAs

- [Setting Up the DSP Builder for Intel® FPGAs License \(HTML | PDF\)](#)

### ARM\* Development Studio 5\* (DS-5\*) Intel SoC FPGA Edition

- [Activating the Arm Development Studio license \(HTML | PDF\)](#)

### MAX+PLUS II (Legacy)

- [Setting up MAX+PLUS II licensing ›](#)
- [Setting up MAX+PLUS II licensing for version 9.1 and higher ›](#)

# 4. Debugging



## 4. Debugging

### Frequently Asked Questions

- [Intel Quartus Prime design software licensing ›](#)
- [MAX+PLUS II software licensing ›](#)
- [IP base suite ›](#)
- [DSP builder for Intel® FPGAs installation and licensing ›](#)
- [Intel® FPGA software installation ›](#)

### Troubleshooter

- This [troubleshooter](#) helps you to solve licensing problems related

### Knowledge Base Solution

- [Why my OpenCL license is not detected in 17.0 when my mainter](#)

# Agenda



Getting Started



Preparation



Software Developers



Hardware Developers



Research



Support



Design Resources

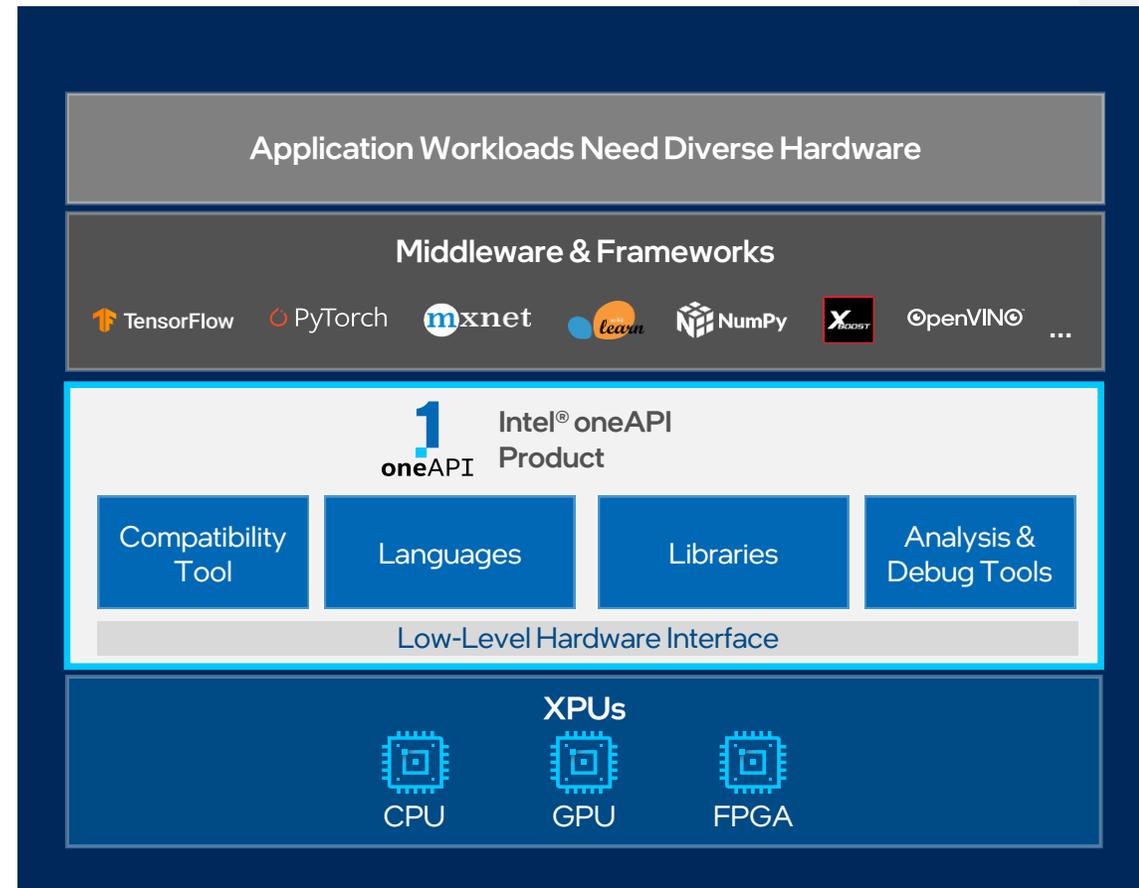
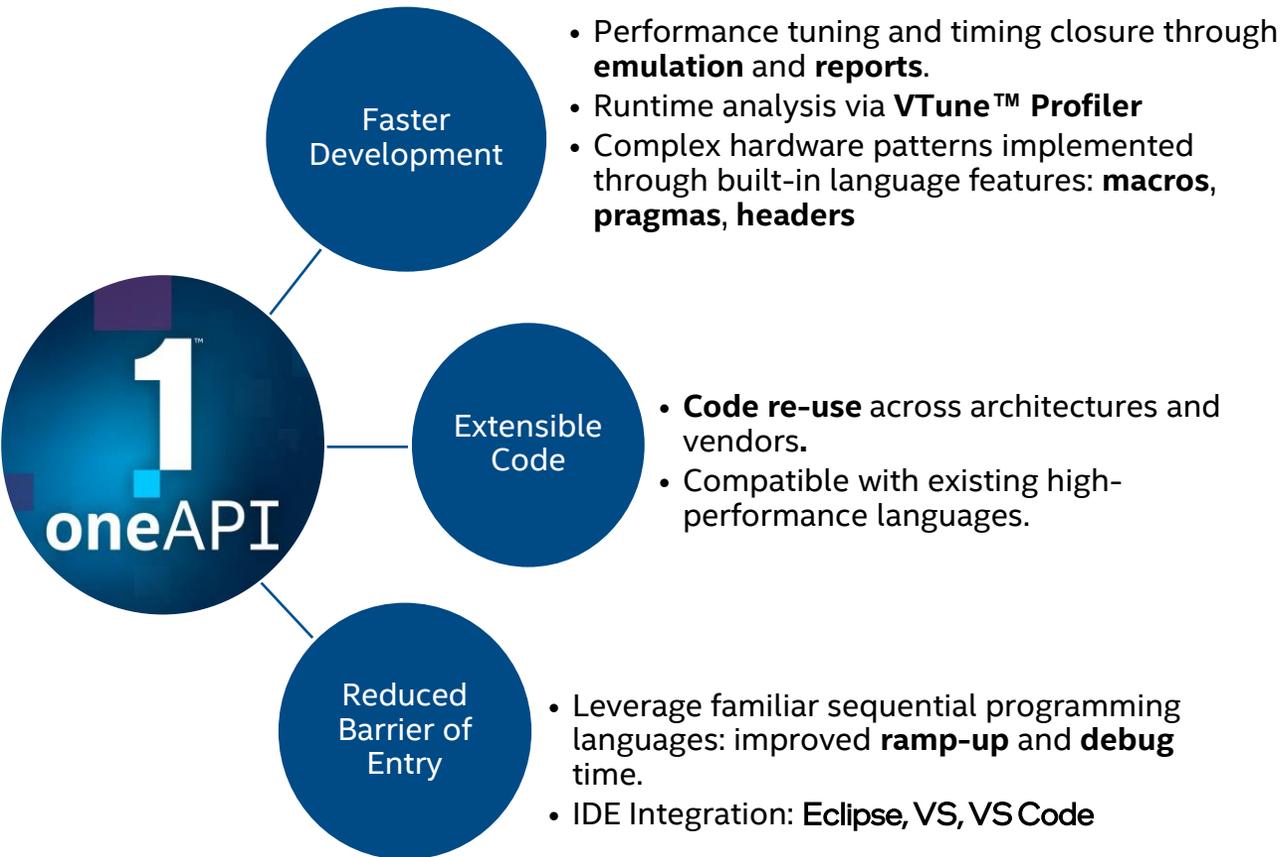
# Software Developers



## Tools and environment familiar to software engineers

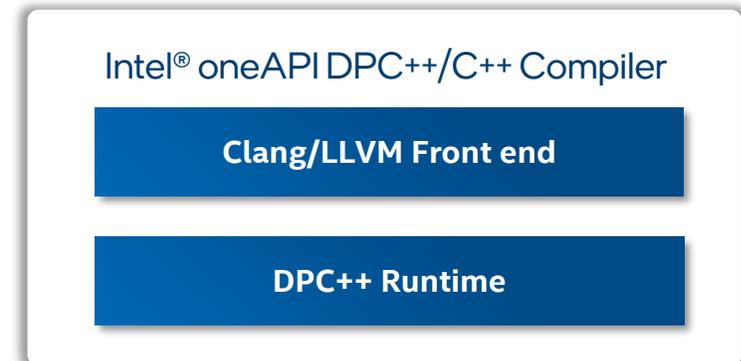
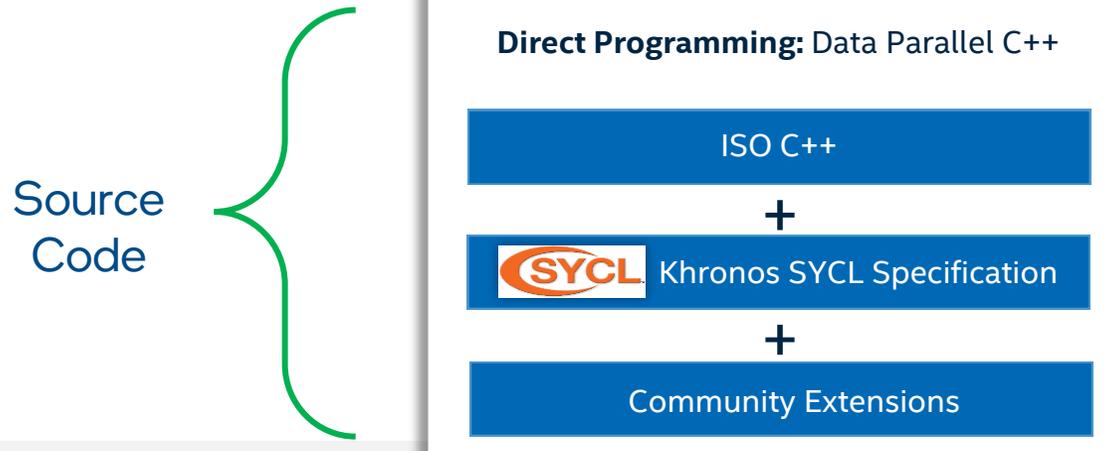
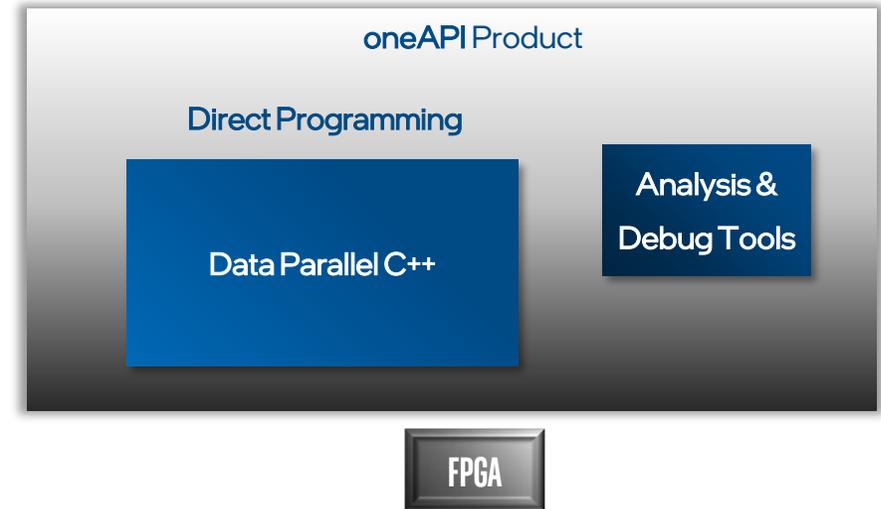
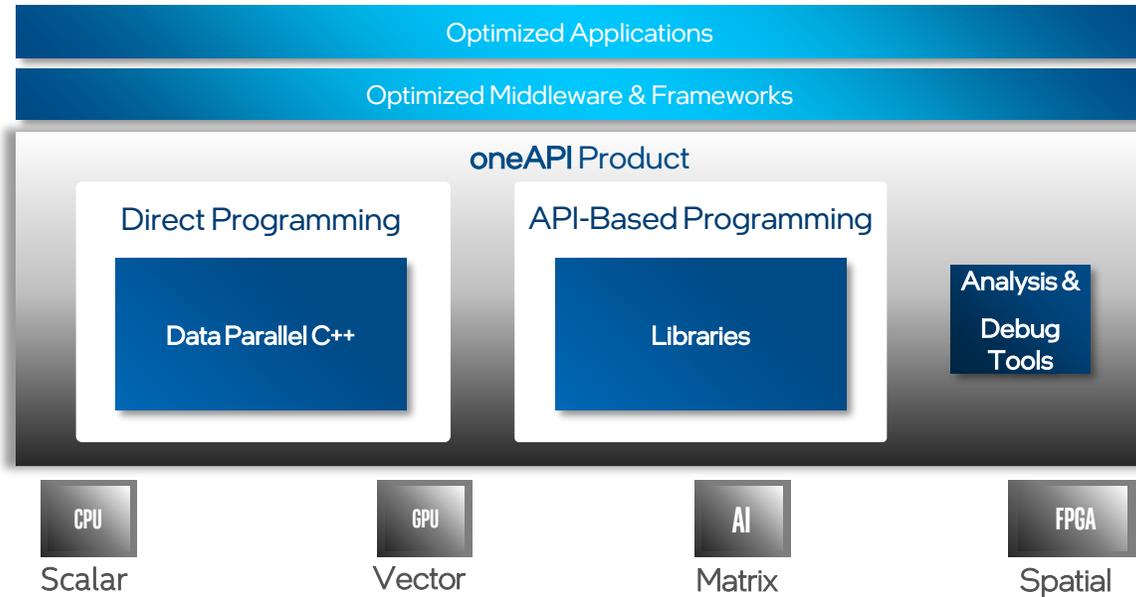
- Leverage the inherent parallel processing nature of Intel FPGAs as accelerators
  - Intel® oneAPI
  - Intel Open FPGA Stack (Intel OFS)
- System on a Chip (SoC) embedded process development
  - Embedded Arm\* Cortex\* hard processor and Nios® V soft processor
  - RTOS support

# Intel® oneAPI Product

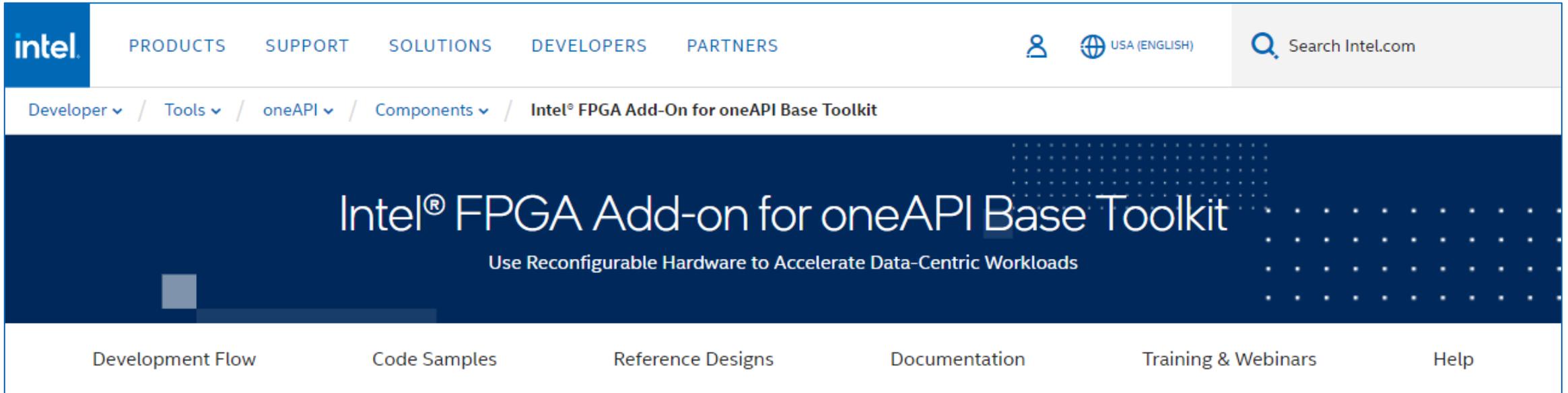


[Available Now](#)

# Intel® oneAPI Base Toolkit for FPGAs



# Intel® oneAPI Base Toolkit for FPGAs More Information



The screenshot shows the Intel website navigation bar with the Intel logo on the left and menu items: PRODUCTS, SUPPORT, SOLUTIONS, DEVELOPERS, PARTNERS. On the right, there are icons for user profile, globe, and language (USA (ENGLISH)), along with a search bar labeled "Search Intel.com". Below the navigation bar is a breadcrumb trail: Developer > Tools > oneAPI > Components > Intel® FPGA Add-On for oneAPI Base Toolkit. The main content area has a dark blue background with the text "Intel® FPGA Add-on for oneAPI Base Toolkit" and the tagline "Use Reconfigurable Hardware to Accelerate Data-Centric Workloads". At the bottom of the main area is a horizontal menu with links: Development Flow, Code Samples, Reference Designs, Documentation, Training & Webinars, and Help.

- <https://www.intel.com/content/www/us/en/developer/tools/oneapi/fpga.html>

# Intel® Open FPGA Stack

- Standardization
- Utilize the Acceleration Functional Unit
- Leverage the Ecosystem
- Ease of Deployment
- Customizations
- Wide-Range of Solutions

## Intel® Open FPGA Stack (Intel® OFS) Enables:



Customization



Faster Time to Deployment



Portability



Ease of Deployment

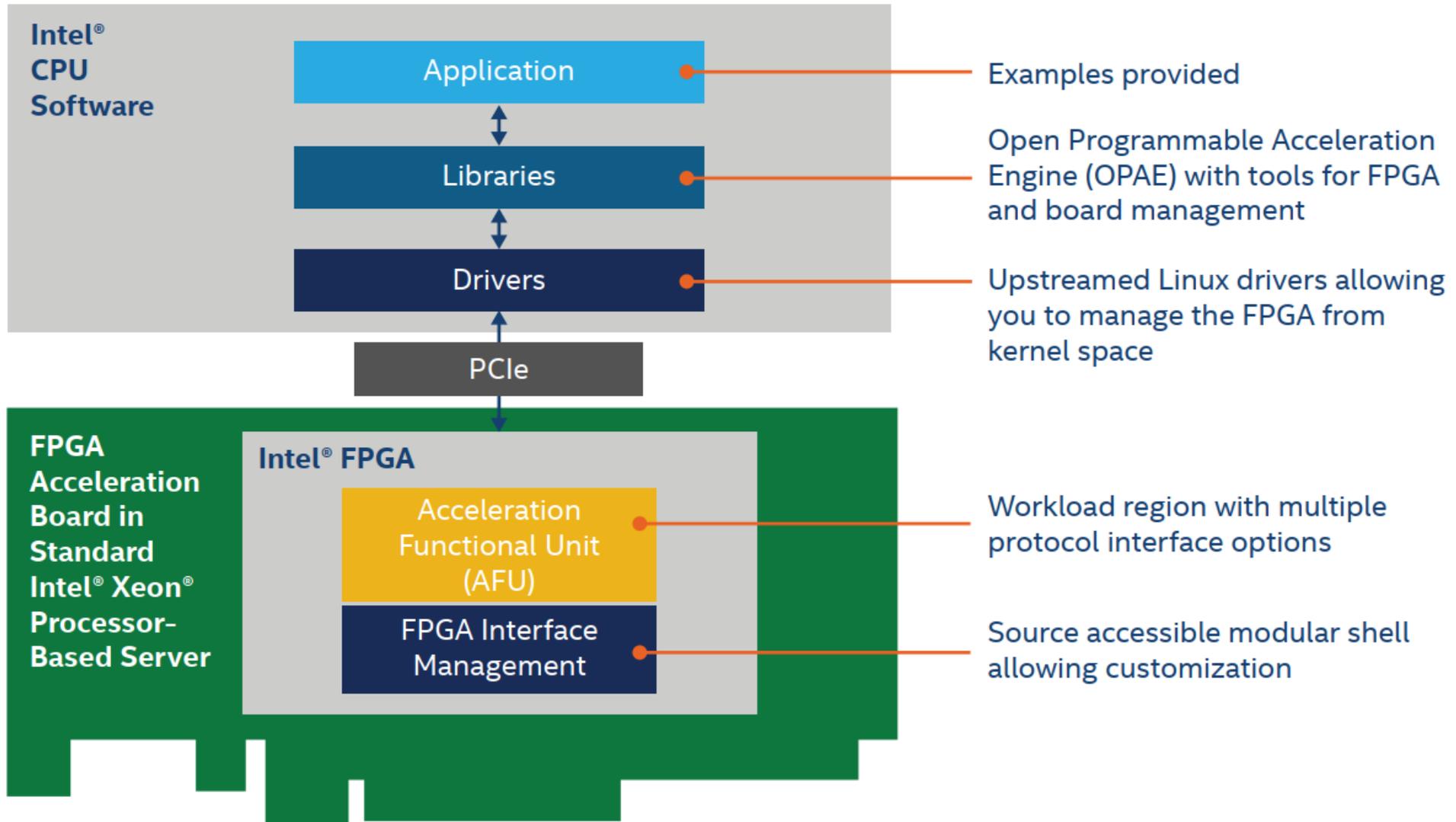


Standardization



Wide-Range of Solutions

# Intel® Open FPGA Stack Block diagram



# Embedded Software



## Arm\* Cortex\* processors and Nios® soft processors

- Multicore embedded Arm Cortex processors
- Nios soft processors
- Embedded software ecosystem
- RTOS support

# The Processors

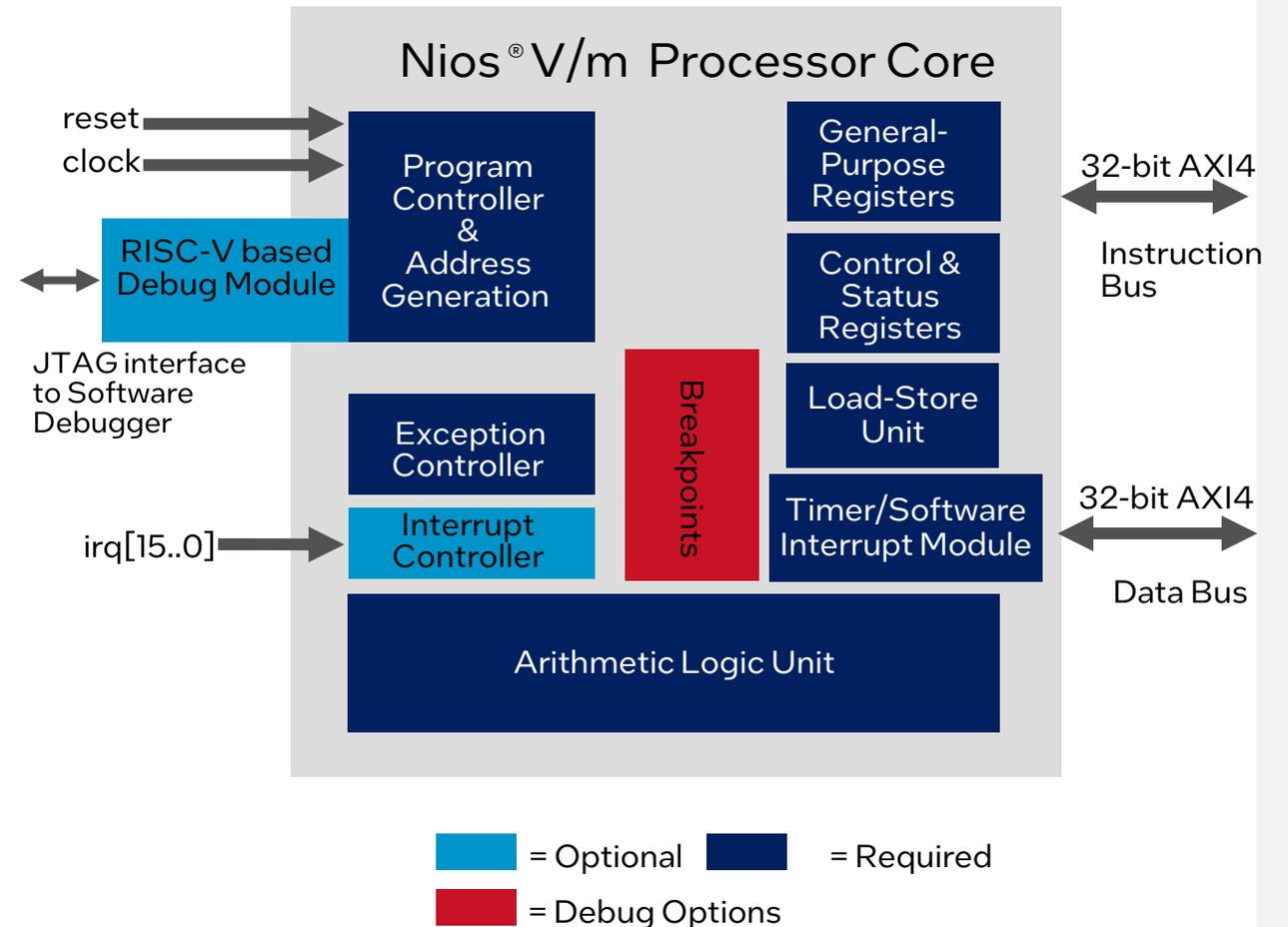


- Intel® FPGA SoC devices contain Arm\* Cortex\* processors
  - Intel Agilex™ & Intel Stratix® 10, quad-core 64 bit Arm Cortex-A53 Hard Processor System (HPS) up to 1.5 GHz
  - Intel Arria® 10, dual-core ARM Cortex-A9 MPCore\* HPS up to 1.5 GHz
  - Arria V, dual-core ARM Cortex-A9 MPCore HPS up to 1.05 GHz
  - Cyclone® V dual-core ARM Cortex-A9 MPCore HPS up to 925 MHz
  - <https://www.intel.com/content/www/us/en/products/details/fpga.html>
- Soft processors
  - Intel Quartus® Standard and Intel Quartus Pro software Nios® II soft processor
  - Intel Quartus Pro software RISC-V based Nios V soft processor
  - <https://www.intel.com/content/www/us/en/products/details/fpga/nios-processor.html>

# Nios<sup>®</sup> V/m Soft Processor



- 32-bit microcontroller based on RISC-V RV32IA
- Initial support on Intel<sup>®</sup> Agilex, Intel Stratix<sup>®</sup> 10, Intel Arria<sup>®</sup> 10, and Intel Cyclone<sup>®</sup> 10 GX devices
- 5 stage pipeline
- Standard interfaces
- Intel<sup>®</sup> HAL, uC/OS-II\*



# Easy Debug



## Initial Development: Open-Source Ecosystem\*

- Eclipse CDT (C/C++ Development Tooling) 10.1.0
- Debug using supported Eclipse-based openOCD
- RISC-V toolchain

\* Eclipse CDT, CMake, RISC-V Toolchain is not included in the Intel® Quartus® Prime Software. Instructions to download and setup are provided

# Nios® V Resources



- Documentation
  - [Nios V Processor Quick Start Guide](#)
  - [Nios V Processor Reference Manual](#)
- Quick Videos available
  - Part 1: [Getting Started with Nios V/m Processor](#)
  - Part 2: [Setting Up Open-Source Tools for Nios V/m Processor](#)
  - Part 3: [Software Development on the Nios V/m Processor](#)
- Separate \$0 license for each core available in the self-service licensing center

## Nios® V/m

Microcontroller

Based on RISC-V: RV32IA, designed for performance, with atomic extensions, 5-stage pipeline, and AXI4 interfaces. Read the Nios® V Processor Reference Manual to learn more about features and performance benchmarks.

- Based on the RISC-V: RV32IA classification
- Microcontroller variant
- 32-bit ISA
- 5-stage pipeline
- AXI4 interfaces
- Host Hardware Abstraction Layer (H2L) support
- UCRIS® support

### Getting Started with Nios® V/m Processor

Learn how to generate and build a simple hello world example design in platform designer for the Nios® V/m processor.

### Setting Up Open Source Tools for Nios® V/m

Learn how to download and set up the open source tools for software development on the Nios® V/m processor.

### Software Development on the Nios® V/m Processor

Learn about software development on the Nios® V/m processor using the open source ecosystem.

# Intel® SoC FPGA Embedded Design Suite



- Comprehensive software / firmware development environment
- FPGA-adaptive software debugging capabilities
  - Arm\* Development Studio for Intel® SoC FPGA edition toolkit
- Hardware / software handoff tools
- Linux\* OS application development
  - Yocto Linux\* OS build environment
  - Pre-built binaries for Linux\* OS / U-Boot
- Work in conjunction with the Community Portal
- Bare-metal application development
  - SoC Hardware Libraries
  - Bare-metal compiler tools
- Design examples

# Arm\* Development Studio for Intel® SoC FPGA



- Code
- Build
- Debug
  - FPGA-Adaptive Debug
  - Program Trace
- Optimize
  - Program Trace
  - Application Performance Analysis

# Intel® SoC FPGA Embedded Design Suite



## For more information:

- Embedded Software and Tools for Intel SoC FPGA
  - <https://www.intel.com/content/www/us/en/software/programmable/soc-eds/overview.html>
- Documentation and Support:
  - <https://www.intel.com/content/www/us/en/support/programmable/support-resources/support-centers/fpga-soc-eds-support.html?s=Newest>

# Agenda



Getting Started



Preparation



Software Developers



Hardware Developers



Research



Support



Design Resources

# Hardware Developers



## FPGA development tools

- Intel® Quartus® software
- Intellectual Property
- DSP Builder for Intel FPGAs
- Intel HLS (high-level synthesis) Compiler

# Intel® Quartus® Software – Three Editions



- Intel Quartus Prime Lite Edition
  - <http://fpgasoftware.intel.com/?edition=lite>
- Intel Quartus Prime Standard Edition
  - <http://fpgasoftware.intel.com/?edition=standard>
- Intel Quartus Prime Pro Edition
  - <http://fpgasoftware.intel.com/?edition=pro>
- Feature comparison
  - <https://www.intel.com/content/www/us/en/software/programmable/quartus-prime/download.html>

# Intel® Quartus® Software



- Fully-integrated development tool
  - Multiple design entry methods
  - Logic synthesis
  - Place & route
  - Device programming
- Simulation
  - Supports standard HDL simulation tools
  - Includes Questa\*-Intel FPGA Starter Edition tool
    - Optional upgrade to Questa-Intel FPGA Edition tool
  - See comparison
    - <https://www.intel.com/content/www/us/en/software/programmable/quartus-prime/questa-edition.html>

# Intel® Quartus® Software



- For more information
  - <https://www.intel.com/content/www/us/en/software/programmable/quartus-prime/overview.html>

# Intellectual Property (IP)



## IP cores optimized for Intel® FPGA devices

- Available from Intel FPGA and our partners
  - <https://www.intel.com/content/www/us/en/products/programmable/intellectual-property.html>
- IP cores included in the **IP Base Suite** are free with an active Intel Quartus® subscription
  - <https://www.intel.com/content/www/us/en/products/programmable/intellectual-property/ip-base-suite.html>
  - Suite license can be purchased for use with the Intel Quartus Lite Edition

# Intellectual Property (IP) (cont.)



## Evaluate Intel® FPGA IP cores and partner IP cores

- Intel Quartus® Prime Pro
  - IP evaluation automatic until purchase of IP license
    - <https://www.intel.com/content/www/us/en/docs/programmable/683416/19-4/ip-evalmode.html>
- Intel Quartus Prime Standard
  - Refer to AN320
    - <https://www.intel.com/content/www/us/en/docs/programmable/683502/17-1/an-320-using.html>

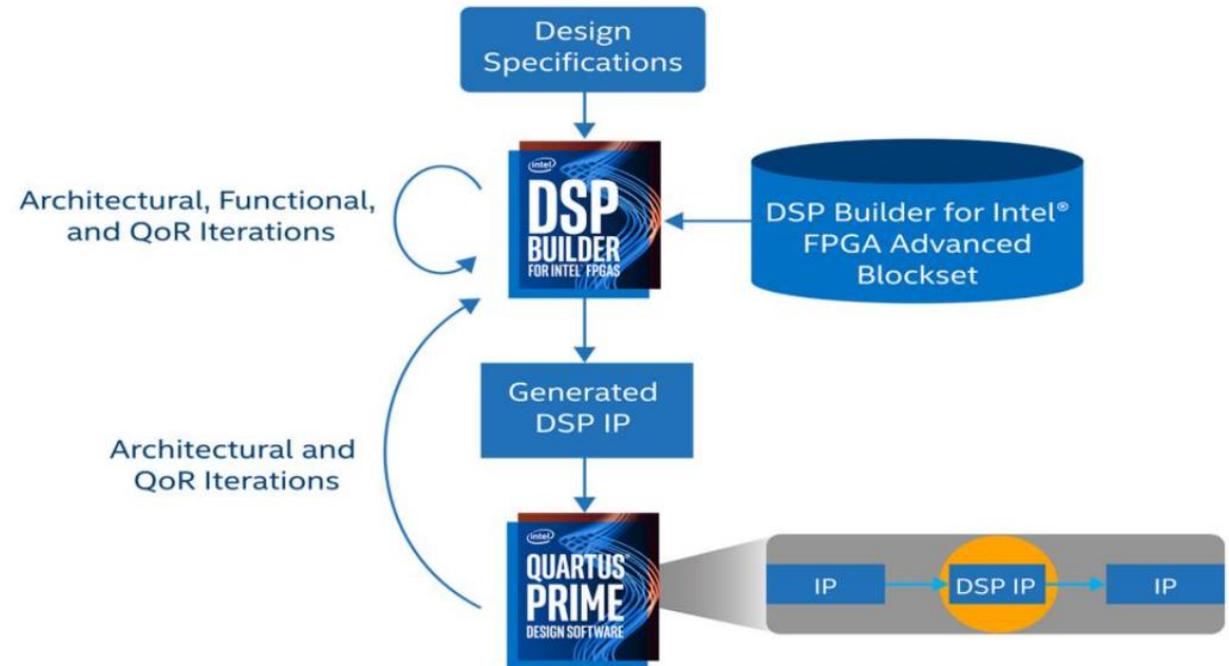
# DSP Builder for Intel® FPGAs



## Generate HDL from MathWorks Simulink\* environment

- Intel® FPGA optimized
- High level design exploration
- HW-in-the-loop verification
- IP generation for Intel Quartus® software and Platform Designer
- For more information

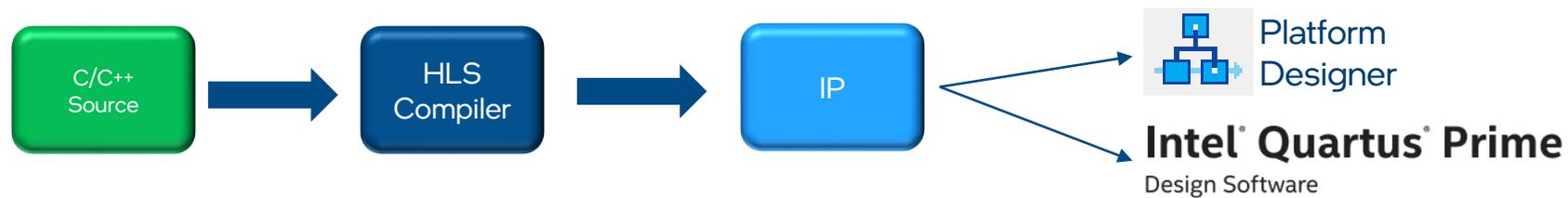
- <https://www.intel.com/content/www/us/en/software/programmable/quartus-prime/dsp-builder.html>





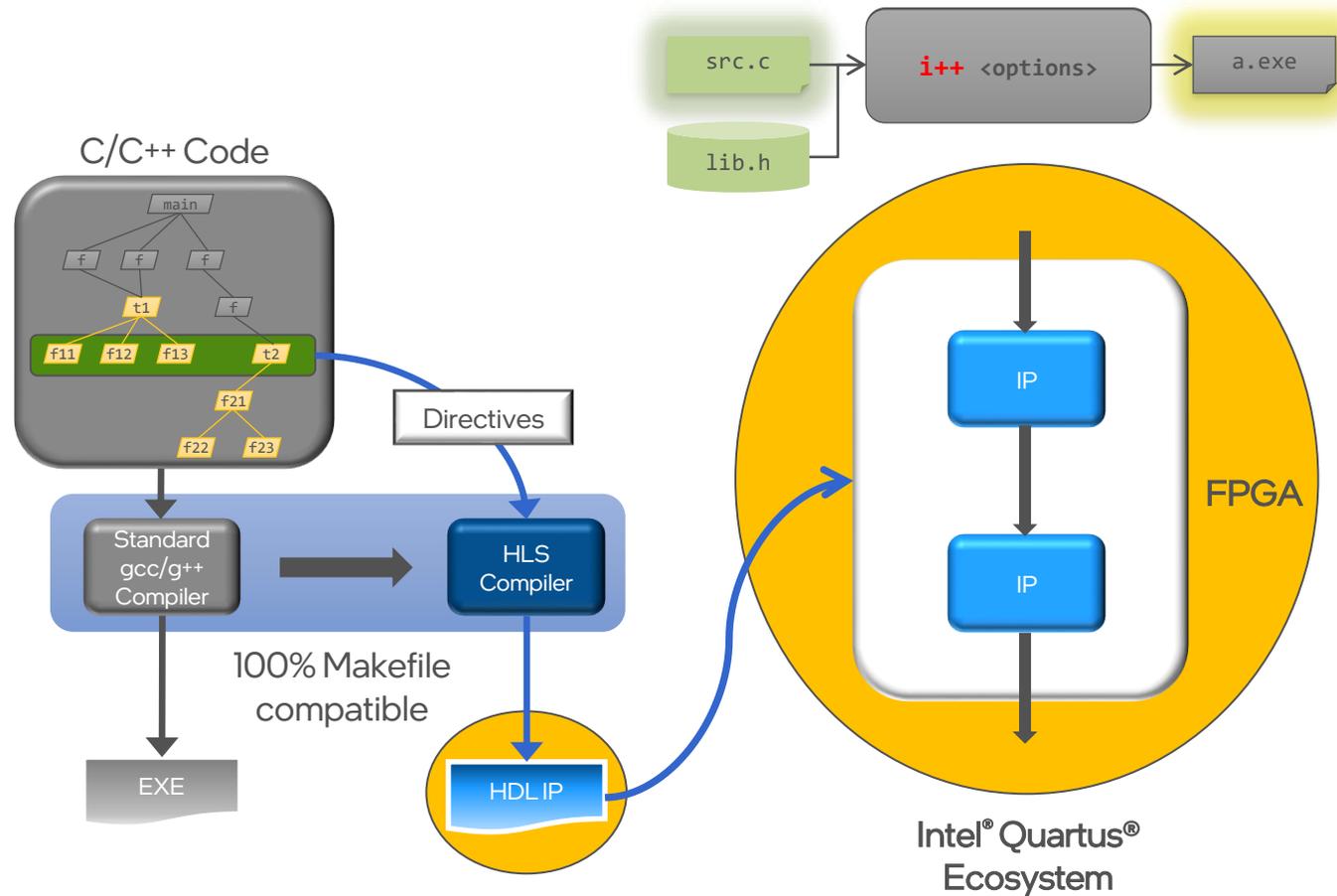
# Intel® HLS (high-level synthesis) Compiler

- Targets Intel FPGAs
- Command-line executable: `i++`
- Builds an IP block
  - Integrate into Intel Quartus® software or Platform Designer



- Leverages standard C/C++ development environment

# HLS Use Model



# Intel® HLS Compiler



- For more information
  - <https://www.intel.com/content/www/us/en/software/programmable/quartus-prime/hls-compiler.html>

# Agenda



Getting Started



Preparation



Software Developers



Hardware Developers



Research



Support



Design Resources

# Research



- Design Examples
- Development Kits
- Design Store
- Devices
- Technology Center
- Documentation

# Design Examples



Many building blocks are available to help you better understand and easily use Intel® FPGA products, implement various functions, and address basic design needs.

- <https://www.intel.com/content/www/us/en/support/programmable/support-resources/design-examples/design-examples-overview.html>
- HDL code samples included to help you get started using Intel FPGA products
- Design entry/tool examples highlight the design entry process
  - Instantiating basic logic blocks
  - Scripting
  - Gate-level timing simulation tools
  - Debugging
- Search by keyword(s) or product descriptions

# Development Kits



There is a wide range of development kits available with everything you need to create, implement, and evaluate

- All kits include software, reference designs, cables, and programming hardware
  - <https://www.intel.com/content/www/us/en/products/details/fpga/development-kits.html>
- For Intel® FPGA development kit technical support
  - <https://www.intel.com/content/www/us/en/support/programmable/support-resources/overview.html>
- Intel FPGA's partners offer development platforms that address a wide range of applications
  - <https://www.intel.com/content/www/us/en/products/details/fpga/find-fpga-boards.html>

# Design Store



- Download complete design project templates
  - <https://www.intel.com/content/www/us/en/support/programmable/support-resources/design-examples/design-store.html>
- Find templates by:
  - Device family
  - Intel® Quartus® software version
  - Development kit
  - IP core
- Templates integrate directly into the Intel Quartus software

The screenshot shows the Intel FPGA Design Store interface. The top navigation bar includes 'intel', 'PRODUCTS', 'SUPPORT', 'SOLUTIONS', 'DEVELOPERS', and 'PARTNERS'. A search bar is located in the top right corner. The main content area is titled 'FPGA Design Store' and displays '437 Results'. A search filter on the left allows filtering by 'FPGA Device Family' and 'Intel Quartus Prime Version'. The search results table lists various design examples with columns for Title, ID, Date, and Version. A blue banner indicates that access to additional search results is restricted, requiring users to sign in or register.

Title	ID	Date	Version
MAX 10 - IO Module Design Example on Intel MAX10 for OPC UA	714783	10/03/21	17.0std.2 Standard
MAX 10 - DC-DC Converter Design Example (AN959)	714606	09/22/21	17.0.2 Standard
Arria 10 - Intel FPGA Remote System Update via PCI Express*	714766	01/20/21	20.4.0 Pro
Stratix 10 - RapidIO II Reference Design for Avalon-ST Pass-Through Interface	714974	01/19/21	17.1.0 Pro
MAX 10 - Drive On Chip motor control and power conversion (Tandem) (AN773)	714645	12/17/20	17.0.2 Standard
Agilex - Design Example: Achieving Timing Closure When Using Top I/O Sub Bank	714634	09/19/20	20.3.0 Pro

# Devices



- Wide range of device series and variants available
  - <https://www.intel.com/content/www/us/en/products/details/fpga.html>
- Device and Product Selector tool
  - <https://ark.intel.com/content/www/us/en/ark.html#@Intel%C2%AEFPGAs>
  - Find and compare Intel® FPGA devices
  - Filter down to specific products based on search specifications
  - Compare products side-by-side by filtering the criteria you choose for analysis

# FPGA Technologies



Access to solutions for many common applications

- <https://www.intel.com/content/www/us/en/products/programmable/technologies.html>

The screenshot shows the Intel website's 'FPGA Technologies' page. The navigation bar includes 'intel', 'PRODUCTS', 'SUPPORT', 'SOLUTIONS', 'DEVELOPERS', and 'PARTNERS'. A search bar is on the right. The main heading is 'Technologies' with the subtext 'Learn about the powerful technologies available to enable your FPGA designs.' Below this is a paragraph: 'With ever-changing workloads and evolving standards, how do you maximize performance while minimizing power consumption in your data center? Learn how this new collection of software, firmware, and tools allow all developers to leverage the power of Intel® FPGAs. Visit the Intel® FPGA Acceleration Hub for more information.' Three featured cards are shown: 1. 'Integrated ADC/DAC' with an image of a 'Direct RF FPGA' chip, described as 'Wide bandwidth, high performance, low power, flexible.' 2. 'Heterogeneous Integration' with an image of an 'Intel Stratix 10' chip, described as 'High performance, low power, and small form factor.' 3. 'Artificial Intelligence' with an image of a human head profile with neural connections, described as 'Learn the benefits of Intel® FPGAs in the growing application of artificial intelligence.' Each card has a 'Learn more' button with a right-pointing arrow.

# Documentation



- Find detailed documentation on all Intel® FPGA devices, IP, and software
  - <https://www.intel.com/content/www/us/en/support/programmable/support-resources/fpga-documentation-index.html>
- Can be viewed online as HTML or downloaded as a PDF

intel PRODUCTS SUPPORT SOLUTIONS DEVELOPERS PARTNERS USA (ENGLISH) Search Intel.com

Intel® FPGA Support Resources / FPGA Documentation Index

## FPGA Documentation Index

Search this collection 3269 Results

Filter by

Curated CLEAR | A-Z

- Development Software (145)
- Intellectual Property (273)
- Recommended (132)

Intel® FPGA Device Family CLEAR

EXPAND ALL | COLLAPSE ALL Newest

Access to additional search results is restricted. Please sign in or register to view

Title	ID	Date	Version	
New				
F-Tile Serial Lite IV Intel® FPGA IP Release Notes	683767	04/04/22	current	↓ ↻

# Documentation: User Guides and White Papers



- **User Guides** provide additional help for:
  - Devices
  - Using IP
  - Development kits
  - <https://www.intel.com/content/www/us/en/support/programmable/support-resources/design-software/user-guides.html>
- **White Papers** written by Intel® FPGA experts to explain:
  - How a technology was developed
  - How a technology is used
  - Product operation for an application, market, or technology
  - <https://www.intel.com/content/www/us/en/programmable/documentation/lit-wp.html>

# Agenda



Getting Started



Preparation



Software Developers



Hardware Developers



Research



Support



Design Resources

# Support



- Knowledge Base
  - <https://www.intel.com/content/www/us/en/support/programmable/kdb-filter.html>
- Intel® Community
  - <https://community.intel.com/t5/FPGA/ct-p/fpga>
- RocketBoards.org
- Support
- Training

# Knowledge Base



## Your questions are answered in the Knowledge Base

- <https://www.intel.com/content/www/us/en/support/programmable/support-resources/overview.html>

The screenshot shows the Intel FPGA Support Resources page. The navigation bar includes 'intel', 'PRODUCTS', 'SUPPORT', 'SOLUTIONS', 'DEVELOPERS', and 'PARTNERS'. The main content area features a large blue header with 'Intel® FPGA Support Resources'. Below this, there are four columns of links:

- Developer Zone Standard Registration**: Register for a Developer Zone profile (previously Intel® FPGA Program) to receive technical support through Intel Community, FPGA Training, Download Center and more.
- Register for Intel® Premier Support for Intel® FPGAs**: Register for Intel® Premier Support for FPGAs (If you work on behalf of a company doing business with Intel. Company information validation required.)
- Intel Community**: Receive support and discuss Intel FPGA products and technologies with user community and Intel experts.
- Knowledge Base**: Get answers for the most common design issues. (This link is circled in red in the image.)



## Join a community forum to learn from each other

- <https://www.intel.com/content/www/us/en/support/programmable/support-resources/overview.html>

The screenshot shows the Intel FPGA Support Resources page. The navigation bar includes 'intel', 'PRODUCTS', 'SUPPORT', 'SOLUTIONS', 'DEVELOPERS', and 'PARTNERS'. The main heading is 'Intel® FPGA Support Resources'. Below this, there are four main sections:

- Developer Zone Standard Registration**: Register for a Developer Zone profile (previously Intel® FPGA Program) to receive technical support through Intel Community, FPGA Training, Download Center and more.
- Register for Intel® Premier Support for Intel® FPGAs**: Register for Intel® Premier Support for FPGAs (If you work on behalf of a company doing business with Intel. Company information validation required.)
- Intel Community**: Receive support and discuss Intel FPGA products and technologies with user community and Intel experts. (This section is circled in red in the image.)
- Knowledge Base**: Get answers for the most common design issues.

# RocketBoards.org for Soc Linux Development



Online community dedicated to running embedded Linux on Intel® SoC devices

- <https://rocketboards.org/>

The screenshot shows the RocketBoards.org website. At the top, there is a navigation bar with the site logo, a search bar, and links for 'Log in', 'Register', and 'Share'. Below the navigation bar is a main menu with 'Home', 'Documentation', 'Community', 'Projects', 'Boards', and 'News'. The main content area features a large banner with the text 'RocketBoards.org' and a sub-headline: 'Accelerate development by exchanging ideas with the Linux community. Discover the right resources for your embedded solutions.' Below the banner is a 'Let's Get Started.' section with a 'START' button and a link to 'Watch the introduction video.' At the bottom, there are six feature cards: 'DOCUMENTATION' (Find information on boards, flows, and open hardware and software), 'CODE' (Access the latest SoC Linux code from our git repositories), 'PROJECTS' (Check out projects submitted by the community to get inspired), 'MAIL LISTS' (Stay updated with latest news, features, questions and feedback), 'FORUM' (Jump into the forum to get help and offer help), and 'BOARDS' (Explore the latest hardware).

# Support



The screenshot shows the Intel website's navigation menu. The Intel logo is on the left. The main navigation bar includes links for PRODUCTS, SUPPORT, SOLUTIONS, DEVELOPERS, and PARTNERS. On the right side of the navigation bar, there is a user profile icon, a globe icon for USA (ENGLISH), and a search bar labeled "Search Intel.com". Below the navigation bar, the "My Intel Dashboard" is visible, with a list of links: Inbox, Support (highlighted with a red box), Content, Training, Events, Community, Inbox Settings, Profile, Programs, and Settings, Subscription Preferences, and Frequently Asked Questions. A "Sign Out" button is located at the bottom of the dashboard. To the right of the dashboard is the "My Tools" section, which lists various resources such as Product Specifications (ARK): CARE Extension, Resource & Documentation Center, Secure Content File Transfer, Customer Notifications Subscription, Digital Power Configurator Download, Intel® FPGA Design Software Download Center, Intel® FPGA Self Service Licensing Center, Intel® FPGA Training, Intel® FPGA University Program, and Product Roadmaps.

# Support – Your Cases



The screenshot shows the Intel Support website interface. At the top, there is a navigation bar with the Intel logo, menu items for PRODUCTS, SUPPORT, SOLUTIONS, and MORE +, a user profile icon, a globe icon for USA (ENGLISH), and a search bar labeled 'Search Intel.com'. Below the navigation bar, there is a breadcrumb trail: 'My Intel Dashboard' with a dropdown arrow and 'Support'. The main content area has a dark blue header with the text 'Support 0 | Open cases' and a button for 'Intel® Customer Support'. Below this, there are four tabs: 'My Open Cases' (which is selected), 'My Closed Cases', 'All Open Cases', and 'All Cases'. The main content area contains a message: 'Have a question? Contact support to find the available support options for your Intel® products.' followed by a blue button for 'Intel® Customer Support'. At the bottom, there is a 'Quick Links' section with a list of links: Profile and Registration Support, Intel® Support (non-FPGA) Legal Agreements, Get Intel® Premier Support, New Support Request Intel Community, and Check Warranty Coverage Entitlement issues.

# Training



## Sharpen your skills

- <https://www.intel.com/content/www/us/en/support/programmable/support-resources/overview.html>

### Additional Resources



#### Development Kits

Simplify the design process with Intel and partner development kits.



#### Design Examples

Get started with Intel FPGA products with ready-to-use design examples.



#### Documentation

Get user guides, data sheets, release notes, and more.



#### Training

Deepen your expertise with Intel FPGA training courses.



#### FPGA University Program

Curriculum, tutorials, hardware and software for students, researchers, and educators.



#### RocketBoards.org

Accelerate development by exchanging ideas with the Linux\* community.



#### How-to Videos

Explore the pool of How-To videos by Intel FPGA engineers.

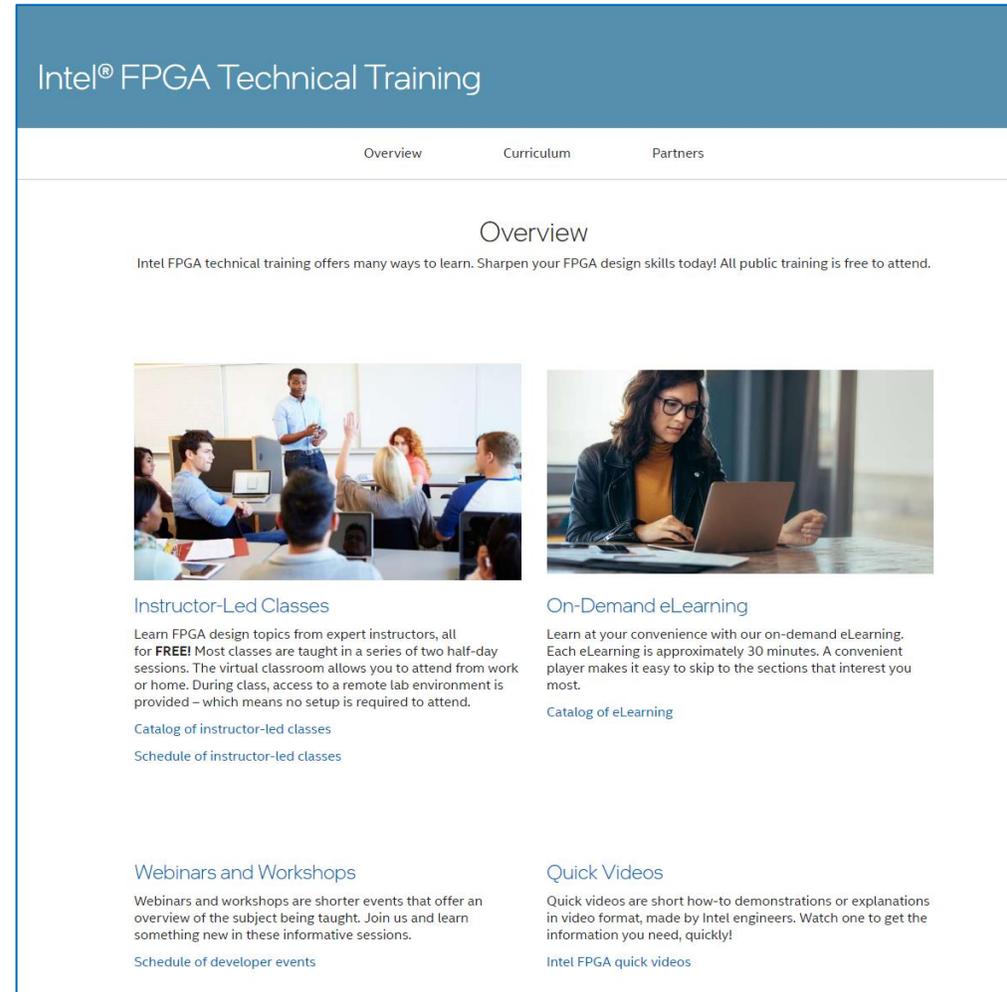


#### Quality and Reliability

Our goal is to consistently meet customers' quality, reliability, and service requirements.

# Training Overview

- Training Curriculum
- Instructor-Led Classes
- On-Demand eLearning
- Quick Videos



The screenshot shows the Intel FPGA Technical Training website. At the top, there is a blue header with the text "Intel® FPGA Technical Training". Below the header, there are three navigation tabs: "Overview", "Curriculum", and "Partners". The "Overview" tab is selected. The main content area is titled "Overview" and contains the following text: "Intel FPGA technical training offers many ways to learn. Sharpen your FPGA design skills today! All public training is free to attend." Below this text, there are four columns of content, each with an image and a title. The first column has an image of an instructor in a classroom and is titled "Instructor-Led Classes". The second column has an image of a woman working on a laptop and is titled "On-Demand eLearning". The third column is titled "Webinars and Workshops". The fourth column is titled "Quick Videos".

Intel® FPGA Technical Training

Overview Curriculum Partners

## Overview

Intel FPGA technical training offers many ways to learn. Sharpen your FPGA design skills today! All public training is free to attend.



### Instructor-Led Classes

Learn FPGA design topics from expert instructors, all for **FREE!** Most classes are taught in a series of two half-day sessions. The virtual classroom allows you to attend from work or home. During class, access to a remote lab environment is provided – which means no setup is required to attend.

[Catalog of instructor-led classes](#)

[Schedule of instructor-led classes](#)



### On-Demand eLearning

Learn at your convenience with our on-demand eLearning. Each eLearning is approximately 30 minutes. A convenient player makes it easy to skip to the sections that interest you most.

[Catalog of eLearning](#)

### Webinars and Workshops

Webinars and workshops are shorter events that offer an overview of the subject being taught. Join us and learn something new in these informative sessions.

[Schedule of developer events](#)

### Quick Videos

Quick videos are short how-to demonstrations or explanations in video format, made by Intel engineers. Watch one to get the information you need, quickly!

[Intel FPGA quick videos](#)



# Training Curriculum

Overview

Curriculum

Partners

## Curriculum

Explore instructor-led classes and eLearnings available for each topic below.

### Intel® Quartus® Prime Software

Learn both the basics and advanced use of the most essential software for developing designs with Intel FPGAs.

[See available classes](#)

### Platform Designer

Learn to construct a system of intellectual property (IP) for your FPGA using this powerful productivity tool.

[See available classes](#)

### Timing Closure

Timing closure is a crucial step in finalizing your FPGA design. Learn the basics and advanced techniques from an expert.

[See available classes](#)

### High-Level FPGA Design

You have more choices for how to design an FPGA than ever before. Learn how to leverage C and C++ based flows for an FPGA.

[See available classes](#)

### Embedded Design

Today, FPGAs are more than just logic. Learn how to implement and program the soft and hard processors inside an FPGA.

[See available classes](#)

### See All Intel FPGA Training

Many more topics are available. Search our extensive catalog.

[See all available classes](#)

# Instructor-Led Training

## Get the most from Intel® FPGA software and devices

- Taught in North America by experienced instructors who can answer your questions
- View and sign up for upcoming classes
  - <https://www.intel.com/content/www/us/en/events/developer/overview.html>
- Contact our training partners outside of North America
  - [https://www.intel.com/content/www/us/en/support/programmable/support-resources/fpga-training/overview.html#editorialtable\\_1548056245](https://www.intel.com/content/www/us/en/support/programmable/support-resources/fpga-training/overview.html#editorialtable_1548056245)

# Web-based Classes

- Conducted live over the Internet
- Interact directly with an Intel® FPGA Technical Training instructor
- Identical content to the in-person class
- Audio provided through Internet interface or separate telephone conference call
- Classes taught in 4.5 hour sessions across consecutive days
- Exercises done through remote hands-on lab interface; no need to install any software locally!

# On-Demand eLearning

## Hundreds of online trainings

- Usually 20-30 minute presentations
- Most training viewable on a computer or any mobile device
- You control the pace of the course
- Free!!



### On-Demand eLearning

Learn at your convenience with our on-demand eLearning. Each eLearning is approximately 30 minutes. A convenient player makes it easy to skip to the sections that interest you most.

[Catalog of eLearning](#)

# Intel® FPGA Quick Videos

- Short, ~5 minute videos
- How-to videos
- A single, concise topic
- Also published to YouTube



- <https://www.intel.com/content/www/us/en/support/programmable/support-resources/fpga-training/fpga-quick-video-index.html>

# Training Partners

Overview	Curriculum	Partners
<h2>Partners</h2> <p>Certified Intel FPGA Training Partners are available to teach in the following regions of the world: Africa, Asia, Australia and New Zealand, Europe, India, Israel, and South America.</p>		
Company	Countries Serviced	Email
<b>Africa</b>		
First Atlantic Semiconductors & Microelectronics	Nigeria	info@fasmicro.com
<b>Asia</b>		
Doulos	All	vic.buzzing@doulos.com
Dream Catcher Consulting Sdn Bhd	Malaysia, Thailand	enquiry@dreamcatcher.asia

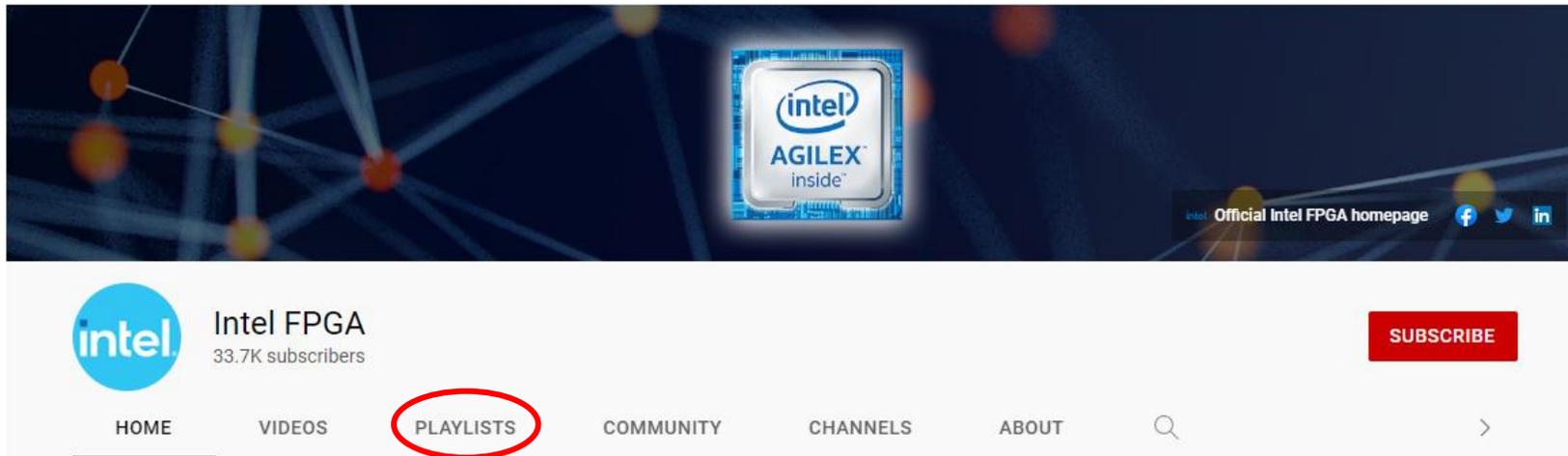
- [https://www.intel.com/content/www/us/en/support/programmable/support-resources/fpga-training/overview.html#editorialtable\\_1548056245](https://www.intel.com/content/www/us/en/support/programmable/support-resources/fpga-training/overview.html#editorialtable_1548056245)

# Training on YouTube



## Subscribe to the Intel® FPGA YouTube Channel

- <https://www.youtube.com/c/IntelFPGA>



- Engineer-to-Engineer playlist
  - Most videos are 5 minutes or less
  - [https://www.youtube.com/c/IntelFPGA/playlists?view=50&sort=dd&shelf\\_id=1](https://www.youtube.com/c/IntelFPGA/playlists?view=50&sort=dd&shelf_id=1)

# Agenda



Getting Started



Preparation



Software Developers



Hardware Developers



Research



Support



Design Resources



# Design Resources

- Ensuring the Success of your Project
- Intel® FPGA Support Resources
- Power Solutions
- Signal Integrity and Power Integrity
- Pin Connections
- Device Review Worksheets
- Design Solutions Partners
- References

# Ensuring the Success of Your Project



- Educate yourself and your team
  - Start with the resources identified in this training
  - Minimize delays and redesign due to incorrect product assumptions
  - Develop a highly skilled team
- Anticipate and keep issues out of your critical path
  - Understand your design flow
  - Evaluate existing boards and solutions
  - Plan your project for maximum efficiency
  - Orchestrate internal resources and external
- Conduct an initial design review
  - A proactive design review may reduce significant design mistakes before they occur
  - Contact your distributor FAE for an Initial Design Review

And again....

# Intel® FPGA Support Resources

- <https://www.intel.com/content/www/us/en/support/programmable/support-resources/overview.html>



The screenshot shows the Intel FPGA Support Resources page. The navigation bar includes 'intel', 'PRODUCTS', 'SUPPORT', 'SOLUTIONS', 'DEVELOPERS', and 'PARTNERS'. The main content area is titled 'Intel® FPGA Support Resources' and is organized into several sections:

- Intel® FPGA Support Resources:** Includes Developer Zone Standard Registration, Register for Intel® Premier Support for Intel® FPGAs, Intel Community, and Knowledge Base.
- Step-by-Step Guidance:** Includes System Architect Developer Center, FPGA Developer Center, Embedded Software Developer Center, and Board Developer Center.
- Technologies:** Includes External Memory Interfaces IP, Ethernet IP, Intel FPGA SDK for OpenCL, Signal Integrity and Power Integrity, Transceiver PHY IP, JESD2048 Intel® FPGA IP, OpenCL™ - BSP, Devices, PCI® Express IP, DisplayPort IP, Embedded Software, and Device Configuration.
- Download:** Includes Download Center, Software Licensing, and Software Download and Installation.
- Additional Resources:** Includes Development Kits, Design Examples, Documentation, Training, FPGA University Program, RocketBoards.org, How-to Videos, Quality and Reliability, and Intel® Solutions Marketplace Design Services.

# Power Solutions



- <https://www.intel.com/content/www/us/en/support/programmable/support-resources/overview.html>

Technologies

 External Memory Interfaces IP	 Transceiver PHY IP	 PCI* Express IP	 Device Configuration
 Ethernet IP	 JESD204B Intel® FPGA IP	 DisplayPort IP	 Intel® Quartus® Prime Design Software
 Intel FPGA SDK for OpenCL	 OpenCL™ – BSP	 Embedded Software	 Power Solutions
 Signal Integrity and Power Integrity	 Devices		

# Power Solutions – Support Center



## Power Solutions - Support Center

1. Power Architecture – The Power Tree

2. Estimation and Optimization

3. Generation and Distribution

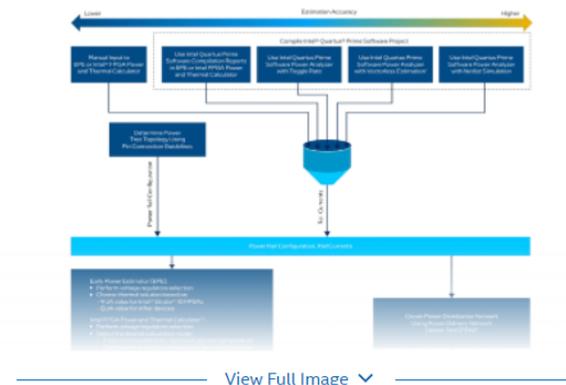
4. Power Dissipation and Thermal Management

Welcome to the Power Solutions support center!

Here you will find information to help you understand power consumption considerations when planning system designs, estimating power requirements throughout the entire design flow, and meeting demanding power requirements using Intel® Enpirion® Power Solution DC-DC converters. These converters feature integrated inductors to deliver an industry-leading combination of high efficiency, small footprint, and low-noise performance.

Enjoy your journey!

Get support resources for **Intel® Agilex™**, **Intel® Stratix® 10**, **Intel® Arria® 10**, and **Intel® Cyclone® 10** devices from the pages below. For other devices, search from the following links—[Documentation Archive](#), [Training Courses](#), [Videos](#), [Design Examples](#), and [Knowledge Base](#).



# Signal Integrity and Power Integrity



- <https://www.intel.com/content/www/us/en/support/programmable/support-resources/overview.html>

Technologies

 External Memory Interfaces IP	 Transceiver PHY IP	 PCI* Express IP	 Device Configuration
 Ethernet IP	 JESD204B Intel® FPGA IP	 DisplayPort IP	 Intel® Quartus® Prime Design Software
 Intel FPGA SDK for OpenCL	 OpenCL™ – BSP	 Embedded Software	 Power Solutions
 Signal Integrity and Power Integrity	 Devices		

# Signal Integrity & Power Integrity – Support Center



## Signal Integrity and Power Integrity – Support Center

Models

Guidelines and Documentation

Training Courses and Videos

Debugging

Welcome to the Signal Integrity and Power Integrity Support Center!

Here you will find information on how to ensure signal integrity and power integrity in your high-speed designs.

Enjoy your journey!

Get support resources for Intel Stratix® 10, Intel Arria® 10, and Intel Cyclone® 10 devices from the pages below. For other devices, search from the following links: [Documentation Archive](#), [Training Courses](#), [Videos and Webcasts](#), [Design Examples](#), and [Knowledge Base](#).

# Pin Connections



- Download pin-out files for each Intel® FPGA device family
  - <https://www.intel.com/content/www/us/en/support/programmable/support-resources/devices/lit-dp.html>
- Understanding how to include an Intel FPGA device on your board can be a complex procedure
  - Get recommendations for connecting pins for specific FPGA families from the Device Pin Connection Guidelines page
  - <https://www.intel.la/content/www/xl/es/programmable/support/literature/lit-dpcg.html>

# Device Review Worksheets



- Device Schematic Review Worksheets
  - Based on respective device [Pin Connection Guidelines](#) and other referenced Intel® FPGA literature applicable to board-level pin connections
  - Important to consider when finalizing board schematics to help find mistakes
  - <https://www.intel.com/content/www/us/en/support/programmable/support-resources/board-layout/fpga-schematic-worksheets.html>

# Device Review Worksheets (cont.)



- Device Layout Review Worksheet
  - Based on guidelines found at the Board Design Guidelines Solution Center (<https://www.intel.com/content/www/us/en/support/programmable/support-resources/quality/brd-index.html>) and other referenced Intel® FPGA literature applicable to board layout techniques and practices
  - Important to consider when finalizing your PCB layout
- All worksheets are downloadable in Word .doc format

# Design Solutions Partners



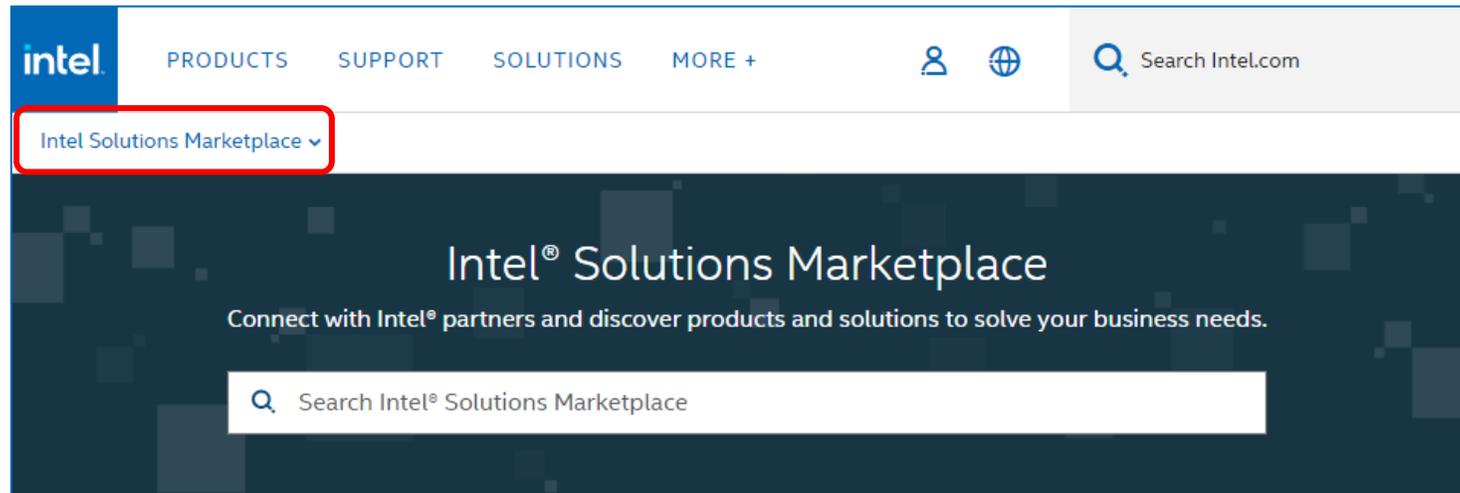
- Sometimes it makes sense to outsource part or all of your project
  - Due to resource limitations, experience, or skill set
- Use the Intel® FPGA network of independent design partners
  - Trained and technically competent
  - Knowledgeable about FPGA products and solutions
  - <https://www.intel.com/content/www/us/en/programmable/solutions/partners.html>

# Summary

- Lots of resources available to you before, during, and at the completion of the design process.
- Use this training as a guide.
- Take advantage of them!
- We're here to help you succeed with your design!

# Contacting a Local Distributor

- Distributors have Intel® FPGA-trained and certified field application engineers (FAEs) to answer your technical questions
- Your distributor offers a variety of services to help you use Intel FPGA products



- <https://marketplace.intel.com/>

# Additional Training and Support Resources



Visit the [Intel® FPGA YouTube channel](#) for more than 1000 trainings and quick videos



Visit the [Intel FPGA training website](#) for eLearning courses narrated in a slide-by-slide player



Enroll in [free instructor-led courses](#) that include interaction and hands-on lab exercises



Still have questions? Visit our [forums](#) that are monitored by skilled applications engineers

# We Welcome Your Feedback

- Intel® FPGA Technical Training Team is continuously looking for ways to improve our training
- Your feedback is an important part of this process
- Please email [fpgatraining@intel.com](mailto:fpgatraining@intel.com) with any thoughts you have on the course you attended

# Legal Disclaimers/Acknowledgements

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- No product or component can be absolutely secure
- Your costs and results may vary
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