



# INTEL<sup>®</sup> FPGA IP

Maximize System Performance and Design Productivity  
with IP Solutions

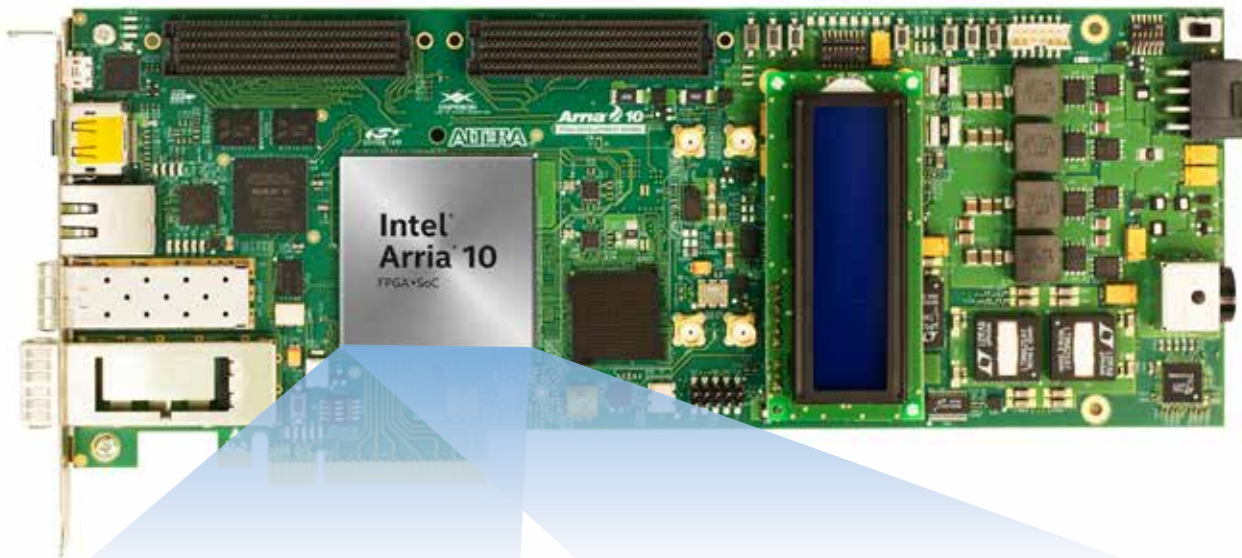
# BROAD PORTFOLIO OF IP

For a system to work, programmable logic devices must be able to communicate with the other devices on the board.

Why is Intel investing in the development, enhancement, and support of a broad intellectual property (IP) portfolio? The reason is simple: for a system to work, programmable logic devices must be able to communicate with the other devices on the board. Therefore, it is imperative for Intel to support various communication interfaces, external memory interfaces, and system building blocks. The capabilities of Intel® FPGAs have gone beyond simple glue logic. They are becoming the heart of many applications, and IP plays a key role in enabling this evolution.

Intel has been developing and licensing IP for over 20 years. From simple arithmetic functions to high-performance communications interfaces, processor subsystems, and application-specific solutions, Intel FPGA IP enables you to create applications on Intel FPGAs for a wide range of markets. The combination of Intel and application-specific IP from a community of trusted partners simplifies your development effort while maximizing design productivity. By utilizing IP, you can implement algorithms and protocol interfaces quickly without needing to know the details.

FIGURE 1. INTEL AND PARTNER IP OPTIMIZED FOR INTEL FPGAS



Intel® FPGA Intellectual Property

 FPGA Design Solutions Network

# ACCELERATED DESIGN PRODUCTIVITY

The process of identifying and qualifying IP is often time consuming. Qualifying the supplier can sometimes take as much time as selecting the IP itself. Because of this, Intel has simplified the IP selection process by enabling the use of IP from Intel and its Design Solutions Network (DSN) members throughout the Intel Quartus® Prime software design flow from the time it is installed.

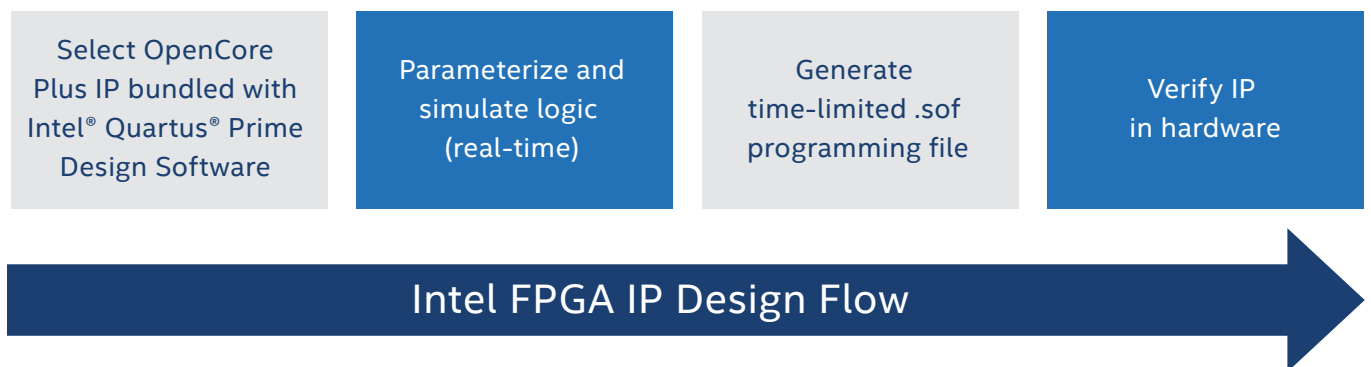
The first step is to download the Quartus Prime design software from our online Download Center. Intel FPGA IP is installed automatically with the Quartus Prime design software and available for immediate use. The IP evaluation flow, called OpenCore Plus, delivers a powerful productivity advantage. With OpenCore Plus, you do not need to acquire a license before evaluating the IP. You can:

- Simulate the core behavior within your system
- Verify the design functionality and quickly evaluate its size and performance
- Generate time-limited device programming files for designs that incorporate the Intel or DSN member IP
- Program a device and verify the design in hardware

The majority of our DSN members also support the OpenCore Plus evaluation feature.

You only need to pay a license fee to obtain production use license rights to the IP when you determine it to be a good fit for your design. No additional product delivery is required. Intel FPGA IP is licensed on a perpetual, royalty-free, per-seat basis, allowing it to be reused in an unlimited number of projects. Once purchased, you can manage your IP licenses via our Self-Service Licensing Center with your myAltera account.

FIGURE 2. INTEL FPGA IP DESIGN FLOW



# COMPLETE SOLUTIONS

Intel offers a complete solution that enables you to acquire the FPGAs, IP, and hardware platforms for initial development from a single source.

This complete solution includes:

- IP in soft and hard format
- Design environment
- Development kits
- Reference designs, design examples, and technical documentation

Intel provides IP in soft and hard formats. The key benefit of hardening IP into devices is resource savings. Hardening pre-proven blocks frees up the logic cells in the FPGA, leaving more room for your design.

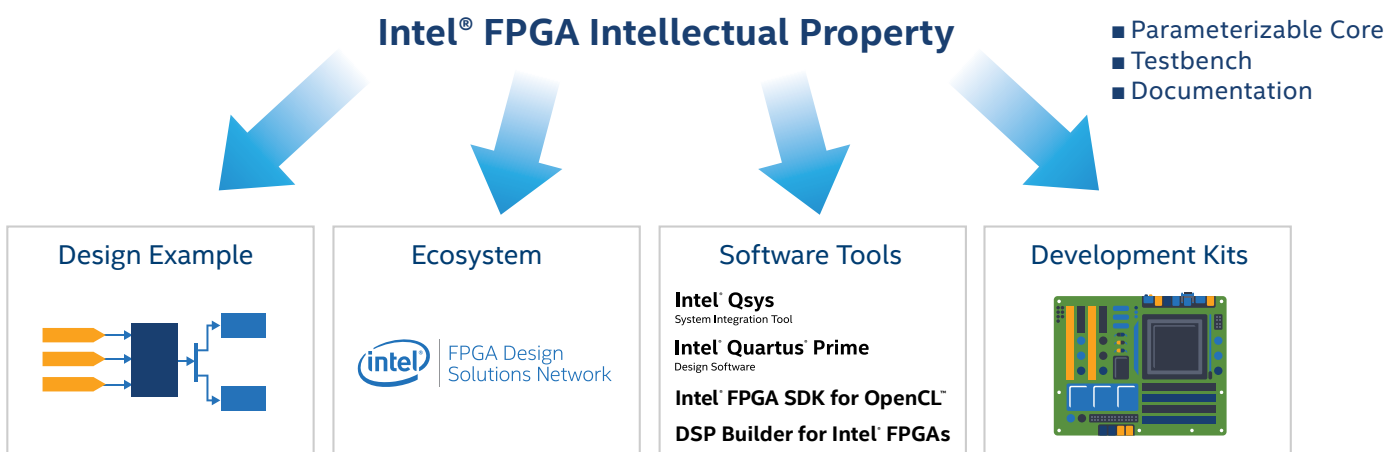
The Intel Quartus Prime design software environment allows you to integrate your own logic with Intel and DSN member IP. With tools such as DSP Builder for Intel FPGAs and Intel FPGA SDK for OpenCL™, your logic does not have to be in a HDL format. The Intel Qsys system integration tool provides an additional productivity advantage by reducing the time needed to integrate the system components.

Intel develops and sells a broad range of development kits for prototype and system design. Application-specific development kits and daughtercards are also available from our DSN member network to improve your design productivity.

Last but not least, Intel and its DSN members offer a wide range of design examples as blueprints to jump start your designs. Some design examples are sample implementations with additional peripherals and interfaces. Others are complete system or sub-system designs for a given application area. Design examples and comprehensive documentation are provided to aid IP integration and initial design verification.

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FIGURE 3. COMPONENTS OF THE INTEL FPGA IP COMPLETE SOLUTIONS



# MULTIPLE NAMES, COMPARABLE QUALITY

Intel FPGA IP is grouped into different categories to help you understand how the IP can be used. All Intel FPGA IP, whether or not free, undergo the same verification methodology to ensure quality. The IP is developed to allow maximum flexibility and usability across a broad range of applications. A parameterization graphical user interface (GUI) enables you to tailor the IP configuration to meet the performance demands of your application.

**TABLE 1. IP ATTRIBUTES**

IP CATEGORY	DESCRIPTION	PARAMETERIZATION GUI	FREE	LICENSE
Intel FPGA IP function	Encrypted IP	✓		✓
Hard Intel FPGA IP function	Hard IP	✓	✓	
Megafunction	Ranges from basic arithmetic to transceiver blocks in source code format	✓	✓	
DSN member IP	Encrypted or source code	✓		✓
Qsys component	IP for use in the Qsys system integration tool	✓	✓	
IP application	Encrypted, full application design (e.g. Optical Transport Network)			✓
Reference design	Subsystem or system blueprints using one or more Intel FPGA IP functions		✓ <sup>1</sup>	
Design example	Ranges from documentation to example implementations of an Intel FPGA IP function		✓	

Notes:  
1. Few exceptions

# PARTNERED WITH EXPERTS



FPGA Design Solutions Network

Intel has been partnering with leading third-party IP developers for over 10 years. These trusted partners bring complementary products and expertise while extending the range of applications you can implement with Intel FPGAs. Through the Intel FPGA DSN program, members gain access to software, training, hardware platforms, IP packaging tools, and direct support from Intel. Member IP is optimized for Intel FPGAs and pre-verified for use.

Table 2 shows a short list of our DSN partners and their technology expertise. For the complete list, please visit [www.altera.com/dsn](http://www.altera.com/dsn).

TABLE 2. SAMPLE DSN MEMBER LIST

PARTNER	EXPERTISE
Arrive Technologies	SONET SDH, Carrier Ethernet, Pseudowire
Bitec	DisplayPort, HDMI, V-by-One IP, Video boards
Algo-Logic Systems	Data Center Rack Solutions for 10G / 40G / 100G Networks
IntelliProp	SATA and SAS
Intilop	10G TCP offload IP
MoreThanIP	Ethernet and Fibre Channel
Northwest Logic	Memory controllers, PCI Express* (PCIe*), and MIPI
Softing	Industrial Factory Automation
System Level Solutions	Computer and Storage (USB, flash memory, and others)

# INTEL AND DSN MEMBER IP FUNCTIONS

[www.altera.com/ip](http://www.altera.com/ip)

For a complete list of IP functions from Intel and its DSN members, please visit [www.altera.com/ip](http://www.altera.com/ip).

	PRODUCT NAME	VENDOR NAME		PRODUCT NAME	VENDOR NAME
DSF	<b>ARITHMETIC</b>		DSP (CONTINUED)	<b>VIDEO AND IMAGE PROCESSING</b>	
	Floating Point Megafunctions	Intel		Video and Image Processing Suite <sup>1</sup>	Intel
	Floating Point Arithmetic Co-Processor	Digital Core Design		HD JPEG 2000 Encoders/Decoders	IntoPIX
	Floating Point Arithmetic Unit	Digital Core Design		TICO Lightweight Video Compression	IntoPIX
	<b>ERROR DETECTION/CORRECTION</b>			Multi-Channel JPEG 2000 Encoder and Decoder Cores	Barco Silex
	Reed-Solomon Encoder/Decoder II <sup>1</sup>	Intel		VC-2 High Quality Video Decoder	Barco Silex
	Viterbi Compiler, High-Speed Parallel Decoder	Intel		VC-2 High Quality Video Encoder	Barco Silex
	Viterbi Compiler, Low-Speed/ Hybrid Serial Decoder	Intel		MPEG-2 TS Encapsulator/Decapsulator for SMPTE2022 1/2	IntoPIX
	Turbo Encoder/Decoder	Intel		JPEG Encoders	CAST, Inc.
	High-Speed Reed Solomon Encoder/Decoder	Intel		Ultra-fast, 4K-compatible, AVC/ H.264 Baseline Profile Encoder	CAST, Inc.
	BCH Encoder/Decoder	Intel		Low-Power AVC / H.264 Baseline Profile Encoder	CAST, Inc.
	Low-Density Parity Check Encoder/Decoder	Intel		H.265 Main Profile Video Decoder	CAST, Inc.
	Zip-Accel-C: GZIP/ZLIB/Deflate Data Compression Core	CAST, Inc.		H.265 Encoders	Jointwave Group LLC
	Zip-Accel-D: GUNZIP/ZLIP/Inflate Data Decompression Core	CAST, Inc.		H.264 Encoders	Jointwave Group LLC
	<b>FILTERS AND TRANSFORMS</b>			Video Processor and Deinterlacer with Line-Doubled Output	Crucial IP, Inc.
	Fast Fourier Transform (FFT)/ Inverse FFT (IFFT)	Intel		Configurable Cross Converter	Crucial IP, Inc.
	Cascaded Integrator Comb (CIC) Compiler	Intel		Video Scaler with Shrink and Zoom Support	Crucial IP, Inc.
	Finite Impulse Response (FIR) Compiler II	Intel		Mosquito / Block Noise Reducer	Crucial IP, Inc.
	SHA-1	CAST, Inc.		Adaptive Detail Enhancer	Crucial IP, Inc.
	SHA-256	CAST, Inc.		<b>HARD/SOFT PROCESSORS</b>	
	AES CODECs	CAST, Inc.		Nios II Embedded Processors <sup>1</sup>	Intel
	<b>MODULATION/DEMODULATION</b>			ARM Cortex-A9 MPCore Processor in Intel SoC	Intel
	Numerically Controlled Oscillator Compiler	Intel		ARM Cortex-A53 MPCore Processor in Intel SoC	Intel
	ATSC and Multi-Channel ATSC 8-VSB Modulators	Commsonic			
	DVB-T Modulator	Commsonic			
	DVB-S2 Modulator	Commsonic			
	Multi-Channel Cable (QAM) Modulator	Commsonic			
		<b>PROCESSORS AND PERIPHERALS</b>			

Notes:  
1. Qsys-compliant licensed core.

	PRODUCT NAME	VENDOR NAME
INTERFACE AND PROTOCOLS	<b>COMMUNICATION</b>	
	Optical Transport Network (OTN) Framers/Deframers	Intel
	SFI-5.1	Intel
	SDN CodeChips	Arrive Technologies
	SONET/SDH CodeChips	Arrive Technologies
	<b>ETHERNET</b>	
	Low-Latency 10 Gbps Ethernet Media Access Controller (MAC) <sup>1</sup> with 1588	Intel
	Triple-Speed Ethernet (10/100/1000 Mbps) MAC and PHY <sup>1</sup> with 1588 Option	Intel
	1 / 2.5 / 5 / 10G Multi-Rate PHY and Backplane Options	Intel
	10G Base-X (XAUI) PHY	Intel
	40G Ethernet MAC and PHY with 1588 and Backplane Options	Intel
	100G Ethernet MAC and PHY with 1588 and RS-FEC options	Intel
	25G MAC and PHY with RS-FEC option	Intel
	50G MAC and PHY	Intel
	1G/10Gb Ethernet PHY	Intel
	Carrier Ethernet CodeChips	Arrive Technologies
	Pseudowire CodeChips	Arrive Technologies
	High-Performance Gigabit Ethernet MAC <sup>1</sup>	IFI
	10 Gigabit Reduced XAUI PCS Core (RXAUI)	MorethanIP
	SPAUI MAC Core	MorethanIP
	20 Gigabit DXAUI PCS Core	MorethanIP
	QSGMII PCS Core	MorethanIP
	2.5 Gbps Ethernet MAC	MorethanIP

Notes:  
1. Qsys-compliant licensed core.

	PRODUCT NAME	VENDOR NAME
INTERFACE AND PROTOCOLS (CONTINUED)	<b>HIGH SPEED</b>	
	JESD204B	Intel
	RapidIO* <sup>1</sup> Gen1, Gen2	Intel
	Common Public Radio Interface (CPRI)	Intel
	Interlaken	Intel
	Interlaken Look-Aside	Intel
	QuickPath Interconnect (QPI)	Intel
	SerialLite II/III	Intel
	SATA 1.0/SATA 2.0	Intelliprop, Inc.
	RapidIO Gen3	Mobiveil
	QDR Infiniband Target Channel Adapter	Polybus
	<b>PCIE / PCI</b>	
	PCIe Gen1 x1 <sup>1</sup> , x4 <sup>1</sup> Controller (Soft IP)	Intel
	PCIe Gen1, Gen2, Gen3 x1, x2, x4, x8, and x16 Controller (Hardened IP)	Intel
	PCI 32/64 bit PCI Master Target 33/66 MHz Controllers	CAST, Inc.
	PCI Multifunction Master/Target Interface	CAST, Inc.
	Expresso 3.0 PCI Express Core (Gen 1 - 3)	Northwest Logic, Inc.
	PCI Express Multiport Transparent Switch	Mobiveil, Inc.
	PCI Express Hybrid Controller	Mobiveil, Inc.
	PCI Express to AXI Bridge Controller	Mobiveil, Inc.
	PCI-X Core	Northwest Logic, Inc.
	PCI Core	Northwest Logic, Inc.
	XpressRICH3 PCIe Gen1, Gen2, and Gen3	PLDA
	PCI and PCI-X Master/Target Cores 32/64 bit	PLDA



	PRODUCT NAME	VENDOR NAME
INTERFACE AND PROTOCOLS (CONTINUED)	<b>SERIAL</b>	
	Generic QUAD SPI Controller	Intel
	Avalon® I <sup>2</sup> C (Master)	Intel
	I <sup>2</sup> C Slave to Avalon-MM Master Bridge	Intel
	Serial Peripheral Interface (SPI)/Avalon Master Bridge <sup>2</sup>	Intel
	UART <sup>2</sup>	Intel
	JTAG UART <sup>2</sup>	Intel
	16550 UART	Intel
	JTAG/Avalon Master Bridge <sup>2</sup>	Intel
	CAN 2.0/FD <sup>1</sup>	CAST, Inc.
	Local Interconnect Network (LIN) Controller	CAST, Inc.
	H16550S UART	CAST, Inc.
	MD5 Message-Digest	CAST, Inc.
	Smart Card Reader	CAST, Inc.
	DI2CM I <sup>2</sup> C Bus Interface-Master	Digital Core Design
	DI2CSB I <sup>2</sup> C Bus Interface-Slave	Digital Core Design
	D16550 UART with 16-Byte FIFO	Digital Core Design
	DSPI Serial Peripheral Interface Master/Slave	Digital Core Design
	Secure Digital (SD)/MMC SPI	El Camino GmbH
	Secure Digital I/O (SDIO)/SD Memory/Slave Controller	Eureka Technology, Inc.
	SDIO/SD Memory/ MMC Host Controller	Eureka Technology, Inc.
	Nios II Advanced CAN <sup>1</sup>	IFI
	I <sup>2</sup> C Master/Slave/PIO Controller	Microtronix, Inc.
	I <sup>2</sup> C Master and Slave	SLS
	USB High-Speed Function Controller <sup>1</sup>	SLS
	USB Full-/Low-Speed Function Controller <sup>1</sup>	SLS
	Embedded USB 3.0 / 3.1 Gen 1 Host and Device Controllers	SLS
	USB 3.0 SuperSpeed Device Controller	SLS

	PRODUCT NAME	VENDOR NAME	
INTERFACE AND PROTOCOLS (CONTINUED)	<b>AUDIO AND VIDEO</b>		
	Character LCD <sup>2</sup>	Intel	
	Pixel Converter (BGR0 to BGR) <sup>2</sup>	Intel	
	Video Sync Generator <sup>2</sup>	Intel	
	SD/HD/3G-HD Serial Digital Interface (SDI)	Intel	
	DisplayPort 1.1 and 1.2	Intel	
	HDMI 1.4 and 2.0	Intel	
	Bitec HDMI 2.0a IP core	Bitec	
	DisplayPort 1.3 IP Core	Bitec	
	HDCP IP Core	Bitec	
	AC'97 Controller	SLS	
	MEMORIES AND MEMORY CONTROLLERS	<b>DMA</b>	
		Scatter-Gather DMA Controller <sup>2</sup>	Intel
		DMA Controller <sup>2</sup>	Intel
		DMA Controllers	Eureka Technology, Inc.
		Lancero Scatter-Gather DMA Engine for PCI Express	Microtronix, Inc.
		AXI* DMA back-End Core	Northwest Logic, Inc.
		Espresso DMA Bridge Core	Northwest Logic, Inc.
Express DMA Core		Northwest Logic, Inc.	
<b>FLASH</b>			
CompactFlash (True IDE) <sup>2</sup>		Intel	
EPCS Serial Flash Controller <sup>2</sup>		Intel	
Flash Memory <sup>2</sup>		Intel	
NAND Flash Controller	Eureka Technology, Inc.		
Universal NVM Express Controller (UNEX)	Mobiveil, Inc.		
ONFI Controller	SLS		
Enhanced ClearNAND Controller	SLS		

Notes:

1. Qsys-compliant licensed core.
2. Qsys component (no license required).

	PRODUCT NAME	VENDOR NAME
MEMORIES AND MEMORY CONTROLLERS (CONTINUED)	<b>SDRAM</b>	
	DDR/DDR2 and DDR3/DDR4 SDRAM Controllers <sup>1</sup>	Intel
	LPDDR2 SDRAM Controller	Intel
	RLDRAM 2 Controller	Intel
	Hybrid Memory Cube Controller	Intel
	Streaming Multi-Port SDRAM Memory Controller	Microtronix, Inc.
	HyperDrive Multi-Port DDR2 Memory Controller	Microtronix, Inc.
	Avalon Multi-Port SDRAM Memory Controller <sup>1</sup>	Microtronix, Inc.
	RLDRAM II and III Controllers	Northwest Logic, Inc.
	LPDDR2/3 Controllers	Northwest Logic, Inc.
	<b>SRAM</b>	
	SSRAM (Cypress CY7C1380C) <sup>2</sup>	Intel
	QDR II/II+/II+Xtreme/IV SRAM Controller	Intel

- Notes:
1. Qsys-compliant licensed core.
  2. Qsys component (no license required).

