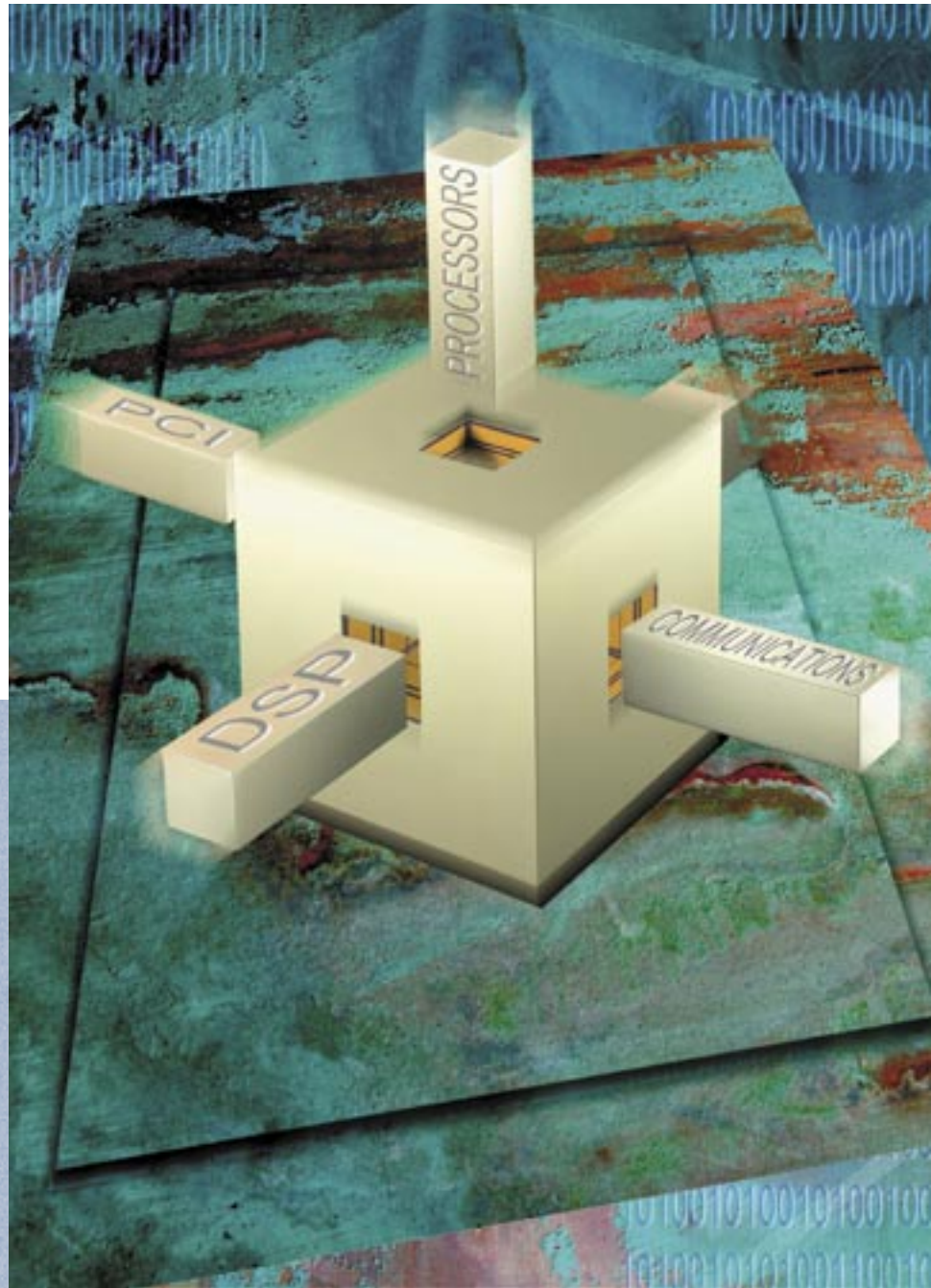




Intellectual Property Selector Guide

IP Functions for System-on-a-Programmable-Chip Solutions



March 2005



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Altera IP Solutions Overview

Altera® intellectual property (IP) functions are reusable and optimized for reprogrammable FPGAs. Altera IP facilitates system development by providing high-performance and configurable functional blocks for all types of applications.

FPGA Advantages

While IP blocks are available for use in both ASICs and FPGAs, ASICs still present significant challenges in terms of tools, engineering resources, and foundry costs. Altera's FPGAs can reduce or eliminate these ASIC design difficulties. The high-performance Stratix® and low-cost Cyclone™ device series deliver design flexibility, reduced time to market, and lower tool costs, making them better alternatives for many applications formerly dominated by ASICs.

Complete IP Solutions

Altera offers a rich portfolio of IP blocks optimized for FPGAs that allows you to implement system-on-programmable-chips (SOPCs) into a single FPGA. Altera also offers a powerful set of industry-leading development software that, in conjunction with its FPGAs and IP blocks, can significantly reduce your development costs and speed time to market. This combination of development software, IP, and programmable logic frees you from re-designing standard functions so that you can spend more time differentiating products.

Extensive IP Portfolio

Altera's IP megafunction portfolio includes more than 200 megafunctions offered by Altera and Altera partners in the Altera Megafunction Partners Program (AMPPSM).

MegaCore Functions



Altera IP MegaCore® functions are high-quality, easy-to-use, pre-verified, configurable, off-the-shelf IP cores. These megafunctions are optimized for the latest Altera devices and are fully supported in Quartus® II design software.

Now you can get all the released Altera IP MegaCore functions on two convenient CDs: the MegaCore IP Library and the Nios® II Embedded Processor Evaluation Edition. Altera ships both CDs with Quartus II software to active Quartus II subscribers. You can also download these functions from the Altera web site at www.altera.com.

AMPP Megafunctions



AMPP Megafunctions are offered by leading third-party IP vendors who are members of Altera's AMPP program. These partners develop and optimize their IP products for Altera devices and license them directly to Altera customers. Many AMPP partners can provide custom integrated SOPC solutions. Altera also has partnerships with leading software vendors to deliver processor-based SOPC software solutions.

Altera IP Features

Altera pioneered plug-and-play IP methodology with MegaWizard® Plug-In Manager parameterization tools, IP Toolbench, and OpenCore® evaluation. You can now achieve new levels of freedom in your IP evaluation and system integration with the addition of Altera's OpenCore Plus evaluation feature.

Products listed in this IP Selector Guide may support one or more of the following features. To get more details, visit Altera's IP MegaStore™ website at www.altera.com/IPmegastore.

IP Toolbench

IP Toolbench, launched from the MegaWizard Plug-In Manager in Quartus II software, allows you to view documentation, specify parameters, set up third-party tools, and generate all the files necessary for integrating the parameterized megafunction into your design.

MegaWizard Plug-Ins



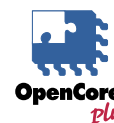
An Altera MegaWizard Plug-In, launched from IP Toolbench, allows you to parameterize the megafunction for your exact system requirements through a powerful graphical user interface (GUI).

OpenCore IP Evaluation








The OpenCore evaluation feature enables you to evaluate functions in Quartus II design software at no charge. You can evaluate all the features of the IP megafunction such as the functionality, the size, and the speed in your system before making a purchase decision. Most AMPP megafunctions support the OpenCore evaluation feature.

OpenCore Plus IP Evaluation



The OpenCore Plus evaluation feature takes OpenCore evaluation one step further. For a design that includes MegaCore or AMPP

Table 1. IP Certifications	
CERTIFICATION	DESCRIPTION
 AMPP Approved	Certifies that the third-party IP core has undergone Altera's thorough, internal review process and has been optimized for Altera devices. All third-party IP listed on Altera's web site carries the AMPP approved certification.
 I-Tested	Awarded to standards-based interface megafunctions, the <i>I-Tested</i> designation certifies that the IP core has been verified in an Altera device on a board for interoperability with application-specific standard products (ASSPs). This hardware verification is carried out in addition to rigorous simulation.
 DSP Builder Ready	Certifies that the IP core has plug-and-play integration with the DSP Builder system integration tool. These cores can be instantiated, parameterized, and simulated from within The MathWorks' MATLAB and Simulink system-level design tools, making it easier for you to design complex digital signal processing (DSP) systems.
 SOPC Builder Ready	Certifies that the IP core has plug-and-play integration with the SOPC Builder system integration tool. These cores support interfaces for the Avalon™ bus and include software drivers, low-level routines, or other software design files.
 Atlantic™ Compliant	Certifies that IP cores are compliant with the Atlantic interface specification, a high-performance point-to-point interface for asynchronous cell- or packet-based transfers. The standard Atlantic interface makes it easy to integrate multiple IP cores and user-designed logic.

functions, it generates IP functional simulation models and time-limited FPGA programming files. Use the OpenCore Plus hardware evaluation to perform board-level design verification before making a purchase decision. All of Altera's MegaCore functions and selected AMPP megafunctions support the OpenCore Plus feature.

IP Certifications

Altera is committed to providing IP cores that work seamlessly with Altera tools and industry-standard interface specifications. Some megafunctions may carry the Altera-defined certifications listed in Table 1 to help you identify appropriate IP cores.

Licensing Altera MegaCore Functions

Altera offers flexible licensing options for MegaCore functions. All MegaCore licenses are for perpetual use, multi-project, and include upgrades and support for one year. After one year, you may purchase a renewal license for the IP function, which also includes support and maintenance for an additional 12 months. Floating and

node-locked licenses are available for all of Altera's MegaCore IP functions. Contact your Altera sales representative or distributor for pricing.

Licensing AMPP Megafunctions

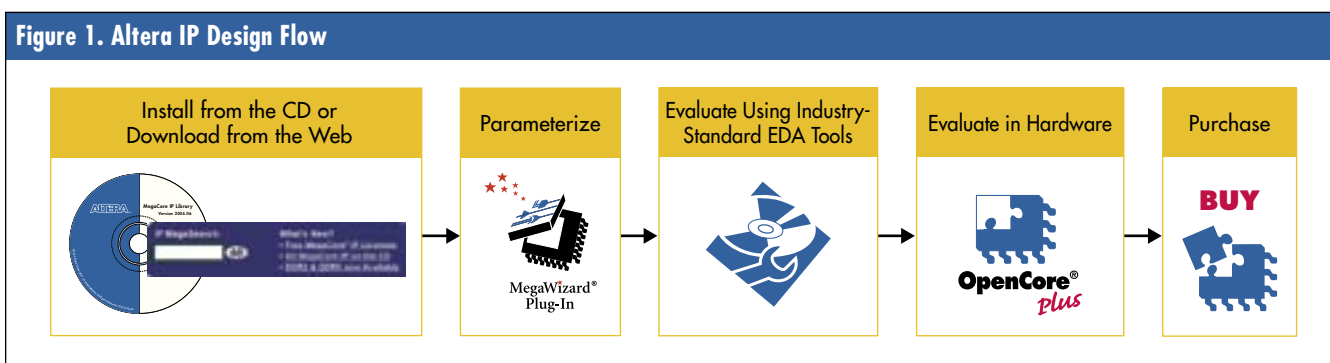
AMPP Megafunctions are available under a variety of licensing terms, conditions, and pricing models. Contact AMPP partners directly for detailed information (see Table 7 on pages 21 to 22).

IP Design Flow

Figure 1 shows the recommended design flow for obtaining, evaluating, and purchasing Altera IP. Visit the Altera IP MegaStore web site at www.altera.com/IPmegastore for a more detailed description of this flow.

Support & Literature

For information on Altera IP support and literature, see Table 8 on page 23.



DSP Solutions

Code:DSP Altera's Code:DSP initiative promotes higher-performance, lower-cost DSP solutions for digital communications, video, and image processing applications such as wireless infrastructure, medical imaging, and military surveillance, among others. The Code:DSP initiative gives you the tools, IP functions, third-party design services, and development platforms you need for implementing DSP designs in Altera's Stratix II, Stratix, Cyclone II, Cyclone, and HardCopy® device families.

Digital Communications Applications

- Mobile wireless – 3G and 4G
- Broadband wireless – 802.16 (WiMAX)
- Wireless pan-access network (PAN) – 802.15
- Broadcast – Advanced Television Systems Committee (ATSC), digital video broadcast (DVB), satellite
- Software defined radio
- Broadband access – cable headends and digital subscriber line access multiplexers (DSLAMs)
- Line echo cancellation
- G.709

Video & Image Processing Applications

- Medical imaging
- Document imaging
- Industrial and military surveillance
- Digital displays standard definition television (SDTV), enhanced definition television (EDTV), high definition television (HDTV)
- Broadcast studio
- Automotive

Tools & IP

MATLAB/ Simulink & DSP Builder

The MathWorks MATLAB and Simulink software tools enable multi-domain simulation and model-based design of dynamic systems. The DSP Builder tool from Altera allows users to develop FPGA-optimized DSP algorithms directly from their Simulink environment, as shown in Figure 2. This powerful tool combination supports both system simulation and hardware creation, reducing the number of design iterations as well as time to market. This step-by-step DSP design flow is further illustrated in Figure 3.

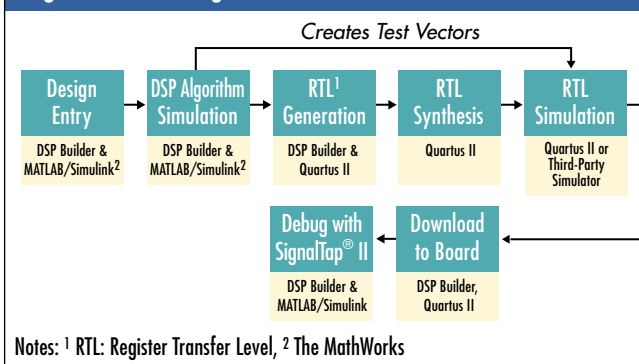
Figure 2. DSP Builder



SOPC Builder

SOPC Builder is an automated integration tool included within Quartus II design software that allows you to easily connect hardware DSP algorithms, created either independently or by DSP Builder, to embedded or external processors. This flow enables you to easily create high-performance, hardware/software SOPC systems.

Figure 3. DSP Design Flow Overview



IP MegaFunctions

Together, Altera and its third-party AMPP partners offer a broad portfolio of FPGA-optimized DSP algorithms covering a range of high-performance digital communications, video, and imaging applications. In addition, the entire feature set of Altera's DSP IP MegaCores are natively supported in the Simulink and DSP Builder environments, enhancing your design flexibility. Table 2 on page 6 lists Altera and AMPP DSP IP megafunctions.

Devices

Stratix II and Cyclone II devices incorporate a variety of DSP performance features such as embedded memory, embedded multipliers, embedded processors, high-speed I/O buffers, and external memory interfaces. Stratix II is the world's fastest and highest density FPGA family. The 384 DSP blocks on the largest Stratix II devices offer performance in excess of 160 18x18-bit giga multiply-accumulate operations per second (GMACS). Cyclone II, the industry's lowest cost FPGA family, also provides up to 150 18x18 embedded multipliers making it an ideal solution for cost-sensitive DSP applications.

Altera and its partners provide many targeted development kit platforms for designing FPGA DSP systems. Please refer to page 16 for more information.

Table 2. DSP IP (Part 1 of 2)		
CATEGORY	FUNCTION DESCRIPTION	VENDOR
Arithmetic	Floating-Point Operator Library	Amphion Semiconductor, Ltd.
	Floating-Point-to-Integer Pipelined Converter	Digital Core Design
	Floating-Point Pipelined Divider Unit	Digital Core Design
	Floating-Point Pipelined Multiplier Unit	Digital Core Design
	Floating-Point Mathematics Unit	Digital Core Design
	Integer-to-Floating-Point Pipelined Converter	Digital Core Design
Correlation	Binary Pattern Correlator	Nova Engineering, Inc.
Encryption/Decryption	Advanced Encryption Standard (AES) Cryptoprocessor	CAST, Inc.
	Data Encryption Standard (DES) Cryptoprocessor	CAST, Inc.
	Secure Hash Algorithm (SHA)	CAST, Inc.
	High-Speed AES Rijndael Decryption	D'crypt Pte. Ltd.
	High-Speed AES Rijndael Encryption	D'crypt Pte. Ltd.
Filtering	Finite Impulse Response (FIR) Compiler	Altera Corporation
Error Detection/Correction	Reed-Solomon Compiler, Decoder	Altera Corporation
	Reed-Solomon Compiler, Encoder	Altera Corporation
	Turbo Decoder Function	Altera Corporation
	Turbo Encoder Function	Altera Corporation
	Viterbi Compiler, High-Speed Parallel Decoder	Altera Corporation
	Viterbi Compiler, Low-Speed/Hybrid Serial Decoder	Altera Corporation
	DVB FEC Codec	Amphion Semiconductor, Ltd.
	Reed-Solomon Decoder	Amphion Semiconductor, Ltd.
	Reed-Solomon Encoder	Amphion Semiconductor, Ltd.
	Viterbi Decoder	Amphion Semiconductor, Ltd.
	Reed-Solomon Decoder	Mentor Graphics
	Reed-Solomon Encoder	Mentor Graphics
	DVB-RCS ¹ Turbo Decoder TC1000	TurboConcept
	Low Complexity Turbo Product Code Decoder TC3401	TurboConcept
	Turbo Product Code Decoder TC3000	TurboConcept
Very High-Speed Turbo Product Code Decoder TC3404	TurboConcept	

Table 2. DSP IP (Part 2 of 2)		
CATEGORY	FUNCTION DESCRIPTION	VENDOR
Image & Video Processing	Color Space Converter	Altera Corporation
	CCIR-656 Decoder	Adaptive Micro-Ware
	CCIR-656 Encoder	Adaptive Micro-Ware
	JPEG 2000 Decoder	Amphion Semiconductor, Ltd.
	JPEG 2000 Encoder	Amphion Semiconductor, Ltd.
	Motion JPEG CODEC	Amphion Semiconductor, Ltd.
	Motion JPEG Encoder & Decoder Functions	Amphion Semiconductor, Ltd.
	MPEG2 Video Decoder	Amphion Semiconductor, Ltd.
	MPEG2 Video Encoder	Amphion Semiconductor, Ltd.
	2D Discrete Cosine Transfer (DCT)/IDCT	Barco Silex
	Fast Black & White JPEG Decoder	Barco Silex
	Fast Color JPEG Decoder	Barco Silex
	Forward Discrete Wavelet Transform	Barco Silex
	Inverse Discrete Wavelet Transform	Barco Silex
	JPEG 2000 Decoder	Barco Silex
	JPEG 2000 Encoder	Barco Silex
	2D Discrete Wavelet Transform (RC_2DDWT)	CAST, Inc.
	Color Space Converter	CAST, Inc.
	Fast JPEG Decoder	CAST, Inc.
	Fast JPEG Encoder	CAST, Inc.
Forward DCT	CAST, Inc.	
Modulation/Demodulation	Complex Tuner	CommStack, Inc.
	Dual Resampler 1Y	CommStack, Inc.
	Dual Resampler 4Y	CommStack, Inc.
	Up Converter	CommStack, Inc.
	Complex Multiplier/Mixer	Nova Engineering, Inc.
	Digital Intermediate Frequency (IF) Receiver	Nova Engineering, Inc.
	Digital Modulator	Nova Engineering, Inc.
Signal Generation	Numerically Controlled Oscillator Compiler	Altera Corporation
	Telephony Gain Generation	Ncomm, Inc.
	Telephony Tone Generation	Ncomm, Inc.
	Numerically Controlled Oscillator	Nova Engineering, Inc.
Speech & Audio Processing	Multi-Standard ADPCM ² Encoder/Decoder	Amphion Semiconductor, Ltd.
	Early/Late-Gate Symbol Synchronizer	Nova Engineering, Inc.
Transforms	Fast Fourier Transform/Inverse FFT (FFT/IFFT)	Altera Corporation
	FFT/IFFT High-Performance 64-Point	Amphion Semiconductor, Ltd.
	FFT/IFFT Low-Latency 64-Point	Amphion Semiconductor, Ltd.

Notes: ¹RCS=Return Channel via Satellite, ²ADPCM=Adaptive Differential Pulse Code Modulation
Check for the latest DSP IP information on the Altera IP MegaStore web site: www.altera.com/IPmegastore.

Communications Solutions

Increasing data traffic requires effective packet transport capability over wide area networks (WAN) and metropolitan area networks (MAN). Historically optimized for time division multiplexed (TDM) traffic, SONET/SDH equipment predominates in the existing WAN and MAN transport infrastructure. Today, standards like virtual concatenation (ITU-T G.707, 2000), generic framing procedure (GFP, ITU-T G.7041), and link capacity adjustment scheme (LCAS, ITU-TG.7042) address increasing data traffic by enabling data transport flexibility in SONET/SDH networks. In addition, the 10 Gigabit Ethernet (GbE) WAN interface sublayer (WIS) (IEEE 802.3ae) also interfaces SONET/SDH.

The Altera communications IP portfolio supports all these standards plus additional widely used protocols like plesiochronous digital hierarchy (PDH) and asynchronous transfer mode (ATM)/frame relay, packet-over-SONET/SDH (POS), and G.709 optical transport network (OTN) digital wrapper and forward error correction (FEC). Altera communications IP cores can be used with Stratix II, Stratix, Stratix GX, Cyclone II, and Cyclone device families. Altera gives you these industry-leading FPGA families and a rich portfolio of communications IP cores to help you meet business challenges and achieve your time-to-market window. Table 3 on page 10 lists Altera and AMPP communications IP megafunctions.

SONET/SDH Functions

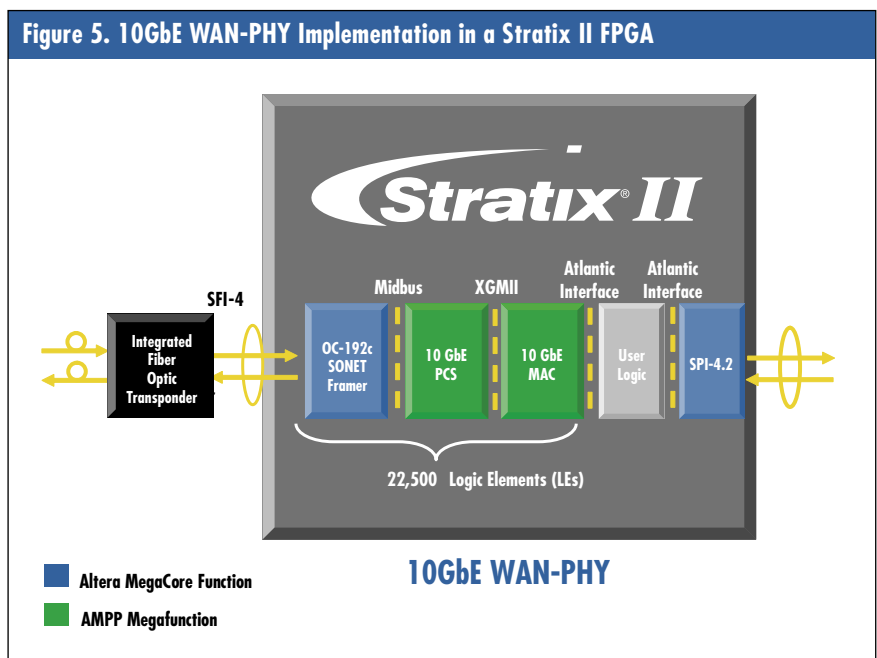
Altera and its partners provide a broad portfolio of functions for the SONET/SDH applications, providing the industry's only single-chip solution for your various communications protocol choices, dramatically reducing board space, power consumption, and cost.

Use Altera's SONET/SDH compiler to configure framing and overhead processing functions for line-rates ranging from OC-1 to OC-192. PDH framing and mapping are also available, as well as Reed-Solomon encoder/decoders used in G.709 FEC. Integrate these functions with proprietary functions for a unique, single-chip solution.

The following are common SONET/SDH frame mapping IP cores available on Altera FPGA products: ATM cell delineation, POS controller, frame-mapped and transparent GFP, VCAT/LCAS controllers, as well as single- and multi-channel high-level data link controller (HDLC) functions.

10 Gigabit Ethernet Functions

AMPP partner MorethanIP provides 10 GbE MAC and 64B/66B physical coding sub-layer (PCS) functions. It is compatible with the Altera OC-192/STM64 SONET/SDH framer configuration, available through the SONET/SDH compiler. Figure 5 illustrates a 10 GbE WAN-PHY implementation in a Stratix II FPGA.



PDH Functions

AMPP partners offer a broad portfolio of PDH functions, including framers and mappers for multi-channel T/E-carrier applications. The T1/E1 mapper supports up to 336/252 T1/E1 channels with the SONET/SDH (STS-12/STM-4) framer in less than 12,000 LEs—the industry's lowest-cost T1/E1 mapping solution.

SerialLite

SerialLite is the world's lightest protocol for chip-to-chip and board-to-board interconnect. The base protocol utilizes an 8B10B PCS with an embedded clock for a baud rate ranging from 622 Mbps to 3.1875 Gbps. The MegaCore

function has packet encapsulation and an Atlantic interface to leverage the embedded PCS functions in Stratix GX devices. Extended optional features are available to tailor the solution to your specific requirements, including scalable channel bonding up to 256 lanes, streaming or packet-based transfers, packet prioritization, cyclic redundancy code (CRC)-16 or CRC-32, flow control, retry on error, and asynchronous or synchronous operation. At only 800 LEs, the base single-lane configuration is less than 12 percent of the size of a 1x Serial RapidIO™ or PCI Express core.

Chip-to-Chip Interface Functions

Altera's communication IP portfolio would not be complete without wide support for the variety of external device interface protocols found in legacy ASICs and ASSPs. Chip-to-chip interfaces are a central part of the system glue, and Altera and its partners provide a range of interface functions for the data path and control plane of communication systems. See the Interface Solutions section on Page 11 for information on control plane interfaces.

POS-PHY Interfaces

Initially defined by the Saturn Development Group as the interface between the PHY and link layers for POS applications, POS-PHY interfaces have become common in a variety of other applications, including GbE, multi-channel GbE, 10 GbE, and ATM. POS-PHY Level 3 and POS-PHY Level 4 have been adopted by the Optical Interconnect Forum (OIF) as SPI-3 and SPI-4.2, respectively.

Altera's POS-PHY Level 4 MegaCore function leverages the dynamic phase alignment (DPA) circuitry embedded in Stratix GX and Stratix II devices—with SPI-4.2-compliant processing logic. This highly configurable function can be used in a variety of applications with support for single-PHY and multi-PHY configurations up to 256 ports.

Altera's POS-PHY Level 2 and 3 compiler delivers configurations for POS-PHY Level 2 and POS-PHY Level 3, and link-layer and PHY-layer interfaces, as well as bridges between these interfaces.

UTOPIA Interfaces

Defined by the ATM Forum, UTOPIA interfaces continue to be widely used to interconnect PHY-layer and ATM-layer devices. Altera and a number of AMPP partners offer UTOPIA interface solutions, including support for UTOPIA Level 2 and Level 3 master and slave functions.

CSIX-L1 & NPSI Interfaces

Defined by the Network Processing Forum, common switch interface layer 1 (CSIX-L1) is an interface between traffic management devices and switch fabric transceivers. CSIX-L1 utilizes a 32-bit interface for OC-48 applications, and 64- or 128-bit interface for OC-192 and 10 GbE applications, with high-speed transceiver logic (HSTL) class I or II signaling.

The Network Processing Forum has defined an alternative protocol to CSIX-L1: Network Processing Forum Streaming Interface (NPSI) based on the OIF's SPI-4.2 interface (16-bit LVDS) with extensions for interconnect between network processing elements and a switch fabric.

For information on Altera High-Speed Interface Development Kits, go to page 16.

Table 3. Communications IP		
CATEGORY	FUNCTION DESCRIPTION	VENDOR
Bluetooth	Bluetooth Baseband Core	NewLogic Technologies
802.11	802.11a WLAN Baseband	Commstack, Inc.
Cell/Packet	ATM Deformatter	Adaptive Micro-Ware
	ATM Formatter	Adaptive Micro-Ware
	AAL5 SAR (Segmentation and Reassembly)	Innocor
	ATM Cell Delineator	Innocor
	Bit Error Rate Tester (BERT)	Innocor
	GFP Controller	Innocor
	POS Controller	Innocor
	Inverse Multiplexing for ATM (IMA)	Modelware
CSIX-L1	CSIX Interface	SOCmagic
Encoding/Decoding	8B10B Encoder/Decoder	Altera Corporation
	Data Encoder/Decoder	Innocor
Flexbus	Flexbus 3 Link-Layer	Modelware
	Flexbus 4 (SPI-4.1)	Modelware
HDLC	Synchronous Data Link Control Protocol (SDLC) Controller	CAST, Inc.
	HDLC, Bit-Oriented	Innocor
	HDLC Single Channel with FIFO Buffers	Mentor Graphics
	Multi Channel HDLC	Modelware
	Single Channel HDLC	Modelware
PDH (T/E Carrier)	T1 Deframer	Adaptive Micro-Ware
	T1 Framer	Adaptive Micro-Ware
	Multi-Channel DS1/E1 Demapper	Aliathon
	Multi-Channel DS1/E1 Mapper	Aliathon
POS-PHY	POS-PHY Level 2 Link-Layer	Altera Corporation
	POS-PHY Level 2 PHY-Layer	Altera Corporation
	POS-PHY Level 3 Link-Layer	Altera Corporation
	POS-PHY Level 3 PHY-Layer	Altera Corporation
	POS-PHY Level 4 (SPI-4.2)	Altera Corporation
	POS-PHY Level 4	Innocor
	POS-PHY Level 4 (SPI-4.2)	Modelware
SONET/SDH	SONET/SDH Compiler (OC-1 to OC-192)	Altera Corporation
	SONET/SDH Deframer (OC-3/STM-1 & OC-12/STM-4)	Aliathon
	SONET/SDH Framer (OC-3/STM-1 & OC-12/STM-4)	Aliathon
SerialLite	SerialLite	Altera Corporation
Ethernet	10/100 Ethernet MAC	CAST, Inc.
	10/100 Ethernet Media Access Controller	Mentor Graphics
	Gigabit Ethernet Media Access Controller	Mentor Graphics
	10/100/1000 Ethernet MAC	MorethanIP
	10 Gigabit Ethernet MAC	MorethanIP
	10 Gigabit Ethernet PCS	MorethanIP
	Gigabit Ethernet to SONET 2+2:1 Multiplexer	Nuvation
	Gigabit Ethernet to SONET 10:1 Multiplexer	Nuvation
Fibre Channel	1G/2G Fibre Channel Transport	MorethanIP
	10 Gigabit Fibre Channel FC-1	MorethanIP
UTOPIA	UTOPIA Level 2 Master	Altera Corporation
	UTOPIA Level 2 Slave	Altera Corporation
	UTOPIA L2 to L3 Multiplexer	SOCmagic
	UTOPIA L3 to L2 De-multiplexer	SOCmagic
Other	IX Bus	Modelware

Check for the latest communications IP information on the Altera IP MegaStore web site: www.altera.com/IPmegastore.

Interface Solutions

SOPC designs often require high-performance, standard interfaces. Altera's interface IP portfolio provides standard interfaces for peripheral component interconnect (PCI)/PCI-X, PCI Express, high-speed memory, RapidIO, HyperTransport™, and universal serial bus (USB). Table 4 on page 13 lists Altera and AMPP interface IP megafunctions.

PCI Interfaces



The PCI local bus is a high performance 32-bit or 64-bit bus with multiplexed address and data lines. Developed for personal computers and servers, PCI is the current system interconnect of choice for many embedded applications including datacom/telecom, industrial automation, imaging, and test and measurement.

Altera's PCI Compiler provides a complete solution for implementing a PCI interface for the Stratix II, Stratix, Stratix GX, Cyclone II, Cyclone, and MAX® II device families. The PCI Compiler contains four Altera PCI MegaCore functions (64-bit master/target, 64-bit target-only, 32-bit master/target, and 32-bit target-only), as well as a Verilog HDL and VHDL testbench and Bus Functional Model (BFM). Altera fully tests PCI MegaCore functions in both software and hardware to meet the latest requirements of the PCI-SIG PCI Local Bus Specification.

Altera also offers PCI megafunctions through its AMPP partners.



The PCI-X local bus introduces several major enhancements to the PCI Local Bus, including:

- Higher clock frequencies, up to 133 MHz
- Signaling protocol changes to enable registered inputs and outputs
- Split transactions eliminating bandwidth-wasting bus retries
- Restricted wait-state and bus disconnection rules for deterministic data transfers
- Improved error recovery

Altera offers PCI-X megafunctions through its AMPP partners.



PCI Express utilizes recent advances in point-to-point interconnects, switch-based technology, and packetized protocols, delivering new levels of performance and features beyond those possible with PCI or PCI-X. Power manage-

ment, quality of service (QoS), hot-plug/hot-swap support, data integrity, and error handling are among some of the advanced features supported by PCI Express. PCI Express maintains important PCI attributes, such as its usage model, load-store architecture, and software interfaces, thereby facilitating easy migration from PCI/PCI-X to PCI Express.

Altera offers PCI Express megafunctions through its AMPP partners.

For information on PCI/PCI-X Development Kits, go to page 16.

Memory Interfaces

Depending on application and memory access requirements, you can choose from a wide array of external memory solutions, including commodity dynamic random access memory (DRAM), specialty DRAM, and SRAM products. Altera delivers complete, hardware-verified external memory controller interface solutions to integrate the following external memory into your FPGA designs:

- SDRAM (DDR, DDR2)—Applications include embedded processor systems, image processing, storage, communications, and networking, among others. The universal adoption of DDR SDRAM in PCs makes DDR a compelling, low-cost, high-density solution for high-bandwidth applications.
- Specialty DRAM (RLDRAM I/II, Network DRAM)—These devices bridge the performance gap between commodity DRAM and SRAM devices. With DRAM memory densities and SRAM-like low latency, these devices are well suited for communications, imaging, and server applications.
- Synchronous SRAMs (QDR, QDRII)—Synchronous SRAMs support the high-throughput, low-latency requirements of communications, networking, and DSP systems. With support for concurrent reads and writes, zero latency, and increased data throughput, synchronous SRAMs offer the highest memory bandwidth to systems where read and write operations are balanced.

The robust and versatile memory interfaces in Altera's FPGAs enable you to quickly and easily connect to a wide variety of external memory devices. Altera memory controller MegaCore functions include complete timing analysis tools, and constraint generators that automate the memory interface design. They are hardware-tested, drop-in design blocks that provide automatic timing and placement scripts, clear-text data path, and system timing tools to ensure that your design meets the

tight timing requirements of external high-speed memory. The dedicated phase-shift circuitry in Stratix series and Cyclone series FPGAs allows memory interface support for up to 300+ MHz external clock frequency, with the flexibility to have multiple memory controllers in the same FPGA design. Altera also offers hardware implementation guidelines derived from a complete board-level system used to demonstrate and validate the memory interface with Altera's FPGAs.

RapidIO

The RapidIO interface is a high-performance, packet-switched interconnect technology, designed to pass data and control information between microprocessors, digital signal processors, communications and network processors, system memory, and peripheral devices.

Altera's RapidIO Physical Layer MegaCore function leverages the Stratix II DPA circuitry and Stratix GX multi-gigabit transceivers with the RapidIO physical layer processing. You can use this configurable function in a variety of applications with support for 8-bit interfaces at up to 1 Gbps and serial support up to 3.125 Gbps. The function provides buffering, flow control, error detection, packet assembly and delineation, port training, user-defined ordering of message retrieval, fixed start-of-packet (SOP) alignment, and configurable Atlantic interface widths and buffer depths.

HyperTransport

HyperTransport universal chip-to-chip communications technology is an advanced high-speed, high-performance, point-to-point link for integrated circuits. HyperTransport provides a universal connection, designed to reduce the number of buses within the system, providing a high-performance link for embedded applications, and enabling highly scalable multiprocessing systems. Originally created to optimize high-performance personal computers, the HyperTransport Consortium expanded this application to provide significant benefits to mobile personal computers, networking equipment, servers, consumer products, and embedded applications.

The Altera HyperTransport MegaCore function implements an end-chain interface optimized for the Stratix II, Stratix, and Stratix GX device families. It supports high-speed packet transfers between PHY- and link-layer devices, and is fully compliant with the HyperTransport specification. This core allows you to interface quickly and easily to a wide range of HyperTransport-enabled devices, includ-

ing network processors, co-processors, video chipsets, and ASICs. The application-side interface of the HyperTransport MegaCore function complies with the Altera Atlantic interface standard.

Next-Generation Interface Standards

Programmable logic design can quickly adapt to next-generation interface standards such as PCI Express 2.0 and advanced switching (AS). Altera works closely with ASSP vendors and the IP development community to give you the bandwidth and flexibility you need for tomorrow's processor systems.

Table 4. Interface IP		
CATEGORY	FUNCTION DESCRIPTION	VENDOR
CAN	Community Area Network (CAN) 2.0 Controller	Mentor Graphics
	Nios-CAN	IFI
	CAN Bus Controller	CAST, Inc.
HyperTransport	HyperTransport Interface	Altera Corporation
I2C	I2C Master	CAST, Inc.
	I2C Slave	CAST, Inc.
	DI2CM I2C Bus Interface-Master	Digital Core Design
	DI2CSB I2C Bus Interface-Slave	Digital Core Design
Memory Controllers	DDR SDRAM Controller	Altera Corporation
	DDR2 SDRAM Controller	Altera Corporation
	QDR II SRAM Controller	Altera Corporation
	SDR SDRAM Controller	Altera Corporation
	Zero-Bus Turnaround (ZBT) SRAM Controller	Altera Corporation
	Advanced High-Performance Bus (AHB) to SDRAM Controller	Eureka Technology Inc.
	SDRAM Controller	Eureka Technology Inc.
	DDR SDRAM Controller	Northwest Logic
	DDR2 SDRAM Controller	Northwest Logic
	FCRAM Controller	Northwest Logic
	SDR SDRAM Controller	Northwest Logic
PCI	PCI Compiler, 32-bit Master/Target	Altera Corporation
	PCI Compiler, 32-bit Target	Altera Corporation
	PCI Compiler, 64-bit Master/Target	Altera Corporation
	PCI Compiler, 64-bit Target	Altera Corporation
	32-Bit PCI Bus Master/Target Interface	Eureka Technology Inc.
	32-Bit PCI Bus Target Interface	Eureka Technology Inc.
	32-Bit PCI Host Bridge	Eureka Technology Inc.
	64-bit PCI Bus Master/Target Interface	Eureka Technology Inc.
	64-bit PCI Bus Target Interface	Eureka Technology Inc.
	64-Bit PCI Host Bridge	Eureka Technology Inc.
	PCI Bus Arbiter	Eureka Technology Inc.
	PCI-ISA Bridge	Eureka Technology Inc.
	PCI-PCI Bridge	Eureka Technology Inc.
	Integrated PCI	Northwest Logic
	PCI Interface	Northwest Logic
	AMBA-AHB PCI Bridge	PLDApplications
	32/64-Bit PCI Bus Master/Target Interface, 33/66 MHz	PLDApplications
32/64-Bit PCI Bus Target Interface, 33/66 MHz	PLDApplications	
Nios-to-PCI Bridge	PLDApplications	
PCI-X	PCI-X Master/Target, 133 MHz	DCM Technologies
	PCI-X Master/Target, 133 MHz	PLDApplications
PCI Express	PCI Express Switch, Endpoint, Root Complex	PLDApplications
Infiniband	Infiniband Link Layer (IBLL)	DCM Technologies
PCMCIA	MPCMCIA1 - PCMCIA Card Interface	Mentor Graphics
	M82365SL - PCMCIA PC Host Interface	Mentor Graphics
PowerPC Bus	PowerPC Bus Arbiter	Eureka Technology Inc.
	PowerPC Bus Master	Eureka Technology Inc.
	PowerPC Bus Slave	Eureka Technology Inc.
RapidIO	RapidIO Physical Layer, Serial & Parallel	Altera Corporation
USB	USB Function Controller	CAST, Inc.
	USB 2.0 Function Controller	CAST, Inc.
	USB 1.1 Function Controller	Mentor Graphics
	USB 2.0 Function Controller	Mentor Graphics

Check for the latest interface IP information on the Altera IP MegaStore web site: www.altera.com/IPmegastore.

Embedded Processor Solutions

Altera delivers fully supported, high-performance embedded processors, along with a comprehensive library of peripherals and memory interfaces such as timers, universal asynchronous receiver/transmitters (UARTs), SDRAM controllers, DMA controllers, and PCI bus bridges. These embedded processor solutions enable you to focus on product differentiation. The existing building-block functions help you create everything from interface line cards to entire communications systems. Table 5 on page 15 lists Altera processor and peripheral IP.

Nios II Embedded Processor

Altera's Nios II family of embedded processors is a set of second-generation, flexible, 32-bit, soft-core processors for use in Altera FPGAs. You can easily optimize them for size and speed. All CPU cores in the Nios II processor family share the same instruction set architecture, ensuring code compatibility and easy migration between CPUs. The Nios II processors give developers flexible instruction as well as advanced features such as data cache sizes, custom instructions, and a multi-CPU system.

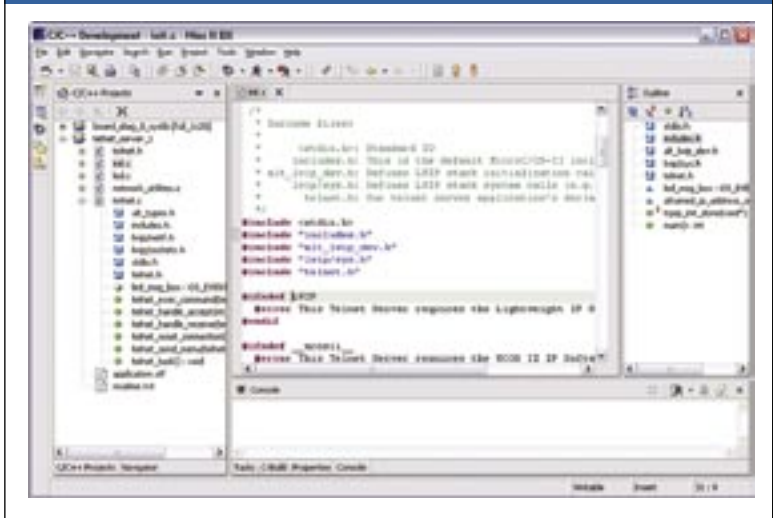
Use the Nios II development tools to create the exact set of hardware and software you need for your system. Build the hardware platform by selecting the set of Nios II CPUs, peripherals, memory, I/O interfaces, and custom-generated components. The Nios II integrated development environment (IDE) delivers a complete software development environment for configuring, editing, compiling, and debugging applications, as shown in Figure 6. Make use of middleware packages, such as real-time operating systems (RTOS) and transmission control protocol/Internet protocol (TCP/IP) networking stacks to accelerate your design cycle.

For information on Altera Nios II Development Kits, go to page 17.

SOPC Builder

SOPC Builder is an automated component-based integration tool included within Quartus II design

Figure 6. Nios II IDE



software. It generates custom embedded microprocessor systems and supports system-level architecture changes that will enable you to analyze performance tradeoffs. SOPC Builder (shown in Figure 7) allows you to easily select and customize system-level building blocks including external processors, Nios and Nios II embedded processors, IP cores, and user-defined components. SOPC Builder automatically integrates these hardware components using the Avalon switch fabric, a high-performance on-chip interconnect technology. SOPC Builder supports application software development by delivering software drivers and software header files matching the hardware, further accelerating the development of working systems.

Figure 7. SOPC Builder

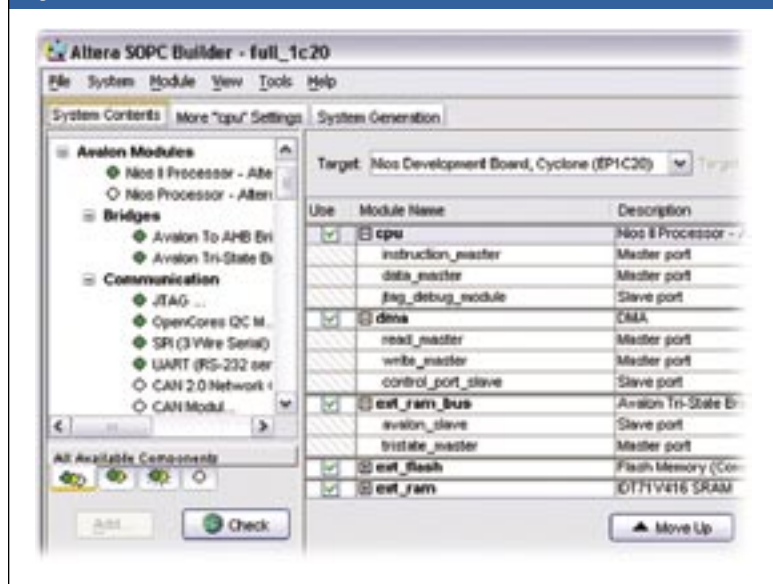


Table 5. Processor & Peripheral IP		
CATEGORY	FUNCTION DESCRIPTION	VENDOR
Processors	ARM922T Hard Embedded Processor	Altera Corporation
	Nios Embedded Processor	Altera Corporation
	Nios II Embedded Processor	Altera Corporation
	4-bit Microprocessor Slice, 2901	CAST, Inc.
	8-bit Microcontroller, 8051	CAST, Inc.
	16-bit Microprocessor, 29116A	CAST, Inc.
	C165X RISC Microcontroller	CAST, Inc.
	C32025 Digital Signal Processor	CAST, Inc.
	C68000 Microprocessor	CAST, Inc.
	CZ80CPU Processor	CAST, Inc.
	R8051 Microcontroller	CAST, Inc.
	R80515 Microcontroller	CAST, Inc.
	R80530 Microcontroller	CAST, Inc.
	DR8051 8-Bit RISC Microcontroller	Digital Core Design
	DR8052EX 8-Bit RISC Extended Microcontroller	Digital Core Design
	Microprocessor, Xtensa	Tensilica
Peripherals	49410 Microprogram Controller	CAST, Inc.
	8255A Programmable Peripheral Interface	CAST, Inc.
	C6845 Cathode Ray Tube (CRT) Controller	CAST, Inc.
	C8237 Programmable DMA Controller	CAST, Inc.
	C8279 Programmable Keyboard/Display Interface	CAST, Inc.
	CZ80CTC Programmable Counter-Timer	CAST, Inc.
	CZ280P10 Programmable Parallel Input/Output Controller	CAST, Inc.
	Microprogram Controller, 2910/2910A	CAST, Inc.
	Microprogram Controller, 49410	CAST, Inc.
	Programmable Interrupt Controller, 8259A	CAST, Inc.
	Programmable Interval Timer/Counter, 8254	CAST, Inc.
	UART, 16450	CAST, Inc.
	UART, 16450S	CAST, Inc.
	UART, 16550	CAST, Inc.
	UART, 16550S	CAST, Inc.
	UART, 16750	CAST, Inc.
	UART, 8250	CAST, Inc.
	Advanced High-Performance Bus (AHB) Master	Eureka Technology Inc.
	AHB Slave	Eureka Technology Inc.
	AHB to PCI Host Bridge	Eureka Technology Inc.
	AHB to SDRAM Controller	Eureka Technology Inc.
	DMA Controller for AHB	Eureka Technology Inc.
	ISA/PC Card/PCMCIA/Compact Flash Host Adapter	Eureka Technology Inc.
	UART	Eureka Technology Inc.
	Programmable Interrupt Controller, 8259	Innocor
	M16550 Enhanced UART with FIFOs and Synchronous Interface	Mentor Graphics
	M16X50 Enhanced UART with FIFO and IrDA	Mentor Graphics
	M8237A – Four-Channel DMA Controller	Mentor Graphics

Check for the latest processor and peripheral IP information on the Altera IP MegaStore web site: www.altera.com/IPmegastore.

Development Kits

Altera and its partners provide you with a variety of hardware platforms to support the creation and verification of your FPGA and CPLD designs (see Tables 6a and 6b on pages 18 to 20). These development kits speed system design by providing test and debug platforms for RTL generation, as well as allowing software engineers to begin the development of application software. If you are a new user, you'll find the Altera development kits easy to master. They contain detailed walk-throughs and example designs supporting Quartus II software, IP design flow, and programming options for Altera devices. In addition, these kits provide a platform for designers to use the OpenCore Plus feature of Altera IP MegaCore functions.

Figure 8. DSP Development Kit



Altera DSP Development Kits

Altera DSP development kits are effective platforms for prototyping and debugging DSP designs for programmable logic. Jump-start your designs for broadband wireless applications by implementing entire modulator/demodulator subsystems in hardware within hours, using the OpenCore Plus feature of Altera's DSP MegaCore functions. DSP development kits give you everything you need out of the box. They include an Altera device, DSP development board, Quartus II software (one-year, time-limited license), DSP Builder (Quartus II MATLAB/Simulink interface), a 30-day evaluation copy of MATLAB/Simulink, and system reference designs. Figure 8 shows an Altera DSP development kit.

Figure 9. High-Speed Development Kit, Stratix II Edition Board



Altera High-Speed Interface Development Kits

Altera offers cost-effective development kits to evaluate high-speed interfaces. As an example, the High-Speed Development Kit, Stratix GX Edition provides GbE, 10 GbE, XAUI, Fibre Channel (1, 2 and 10 Gbps), SONET/SDH (OC-12 and OC-48), SPI-4.2, serial digital interface (SDI), and Serial RapidIO interfaces. The Stratix II edition supports MSA-300 compliant OC-192 optics, SPI-4.2, 8-bit parallel RapidIO, HyperTransport, PCI-X, and DDR2 SDRAM. Figure 9 shows the board included with the High-Speed Development Kit, Stratix II Edition.

Figure 10. PCI Development Kit, Stratix Edition



Altera PCI/PCI-X Development Kits

Altera's PCI development kits provide a flexible hardware platform to quickly begin hardware testing and validation of your PCI-based design. With a variety of memory, interfaces, and peripherals available on the standard PCI card form factor, the PCI development kits offer a com-

plete design environment with support for 32- or 64-bit, 33- or 66-MHz PCI, as well as PCI-X operations. Each board comes with a user application and a library of reference designs to exercise PCI transactions out of the box. OpenCore Plus hardware evaluation enables designers to use these kits as the perfect prototyping platform for a variety of interface IP. Use the development kits for evaluation of the PCI core and for rapid prototyping and debugging in a real-time environment. Figure 10 shows the PCI Development Kit, Stratix Edition.

Altera Nios II Development Kits

Nios II development kits include everything you need for embedded processor system development. The kits include the Nios II family of embedded processors, the Nios II IDE software development tool chain, the SOPC Builder tool and access to over 60 peripheral IP cores, Quartus II design software (one-year, time-limited license), a feature-rich FPGA development board (including power supply, USB-Blaster™ download cable, and other cables), extensive reference designs, tutorials, and complete documentation. Nios II development kits are available for several Altera FPGA families: Stratix II, Stratix, and Cyclone. Figure 11 shows the Nios II Development Kit, Stratix Edition.

Figure 11. Nios II Development Kit, Stratix Edition



Table 6a. Development Kits (Part 1 of 2)

VENDOR	KIT NAME	DEVICE
Altera Corporation	MAX II Development Kit	MAX II
Altera Corporation	DSP Development Kit, Stratix II Edition	Stratix II
Altera Corporation	High-Speed Development Kit, Stratix II Edition	Stratix II
Altera Corporation	Nios II Development Kit, Stratix II Edition	Stratix II
Altera Corporation	High-Speed Development Kit, Stratix GX Edition	Stratix GX
Altera Corporation	DSP Development Kit, Stratix Edition	Stratix
Altera Corporation	DSP Development Kit, Stratix Professional Edition	Stratix
Altera Corporation	Nios II Development Kit, Stratix Edition	Stratix
Altera Corporation	Nios II Development Kit, Stratix Professional Edition	Stratix
Altera Corporation	PCI Development Kit, Stratix Edition	Stratix
Altera Corporation	PCI High-Speed Development Kit, Stratix Professional Edition	Stratix
Altera Corporation	Nios II Development Kit, Cyclone Edition	Cyclone
AleaREP	TWISTER DDR-SDRAM Evaluation Kit	Cyclone
AleaREP	Lancelot VGA Development Kit	Daughter Card
American Arium	REF-XA4 Development Kit	Excalibur™
Arrow	MAX 3000A Quick Start Development Kit	MAX
Ateme	DMCK: DSP-FPGA Co-Processing Development Platform	Cyclone
CEPD, Inc	CAS10 Stratix Development Board	Stratix
CEPD, Inc	HSA II	Daughter Card
Dallas Logic	ezFPGA-Cyclone EP1C3 Prototyping & Evaluation Kit	Cyclone
Dallas Logic	SOckit-Cyclone EP1C6 Nios/LVDS Evaluation Kit	Cyclone
EasyFPGA	EZ1KNiosUSB	ACEX®
EasyFPGA	EZUSB	Daughter Card
El Camino GmbH	DIGILAB SX High-End Prototyping System	Stratix
El Camino GmbH	DIGILAB CC Development Kit	Cyclone
El Camino GmbH	DIGILAB 1Kx208	ACEX
El Camino GmbH	DIGILAB 20Kx240	APEX™
El Camino GmbH	DIGILAB megAPEX	APEX
El Camino GmbH	DIGILAB XA Development Board	Excalibur
El Camino GmbH	DIGILAB picoMAX	MAX
El Camino GmbH	ANDILAB 76	Daughter Card
Future Electronics	Cyclone/Nios II Evaluation Kit	Cyclone
GiDEL Limited	PROC2S Stratix II 60 FPGA Board	Stratix II
GiDEL Limited	PROCStarII	Stratix II
GiDEL Limited	PROC1S Stratix 80 FPGA Board	Stratix
GiDEL Limited	PROCSuperStar Stratix 80 Board	Stratix
GiDEL Limited	PROC20K	APEX
GiDEL Limited	PROC20KE	APEX
Microtronix Inc	Microtronix Stratix Development Kit	Stratix
Microtronix Inc	Microtronix Cyclone Development Kit	Cyclone
Microtronix Inc	µKit	Cyclone
Microtronix Inc	MicroC/OS-II Development Kit	Cyclone
MJL Inc	MJL HardCopy Stratix Prototyping Kit	Stratix
MJL Inc	MJL Stratix Development Kit	Stratix
MJL Inc	MJL Cyclone Development Kit	Cyclone
Nova Engineering	Constellation APEX 20KE	APEX
Parallax Inc.	Parallax Stratix II SmartPack (EP2S60)	Stratix II
Parallax Inc.	Parallax Stratix SmartPack (EP1S10)	Stratix
Parallax Inc.	Parallax Stratix SmartPack (EP1S25)	Stratix

Table 6a. Development Kits (Part 2 of 2)		
VENDOR	KIT NAME	DEVICE
Parallax Inc.	Parallax Cyclone FastPack	Cyclone
Parallax Inc.	Parallax Cyclone SmartPack	Cyclone
Parallax Inc.	PX USB Loader	Daughter Card
PLDApplications	PCI Express XpressBridge	Stratix GX
PLDApplications	Advanced Stratix PCI-X/PCI Development Kit	Stratix
PLDApplications	PCI-X SYS Board	Stratix
PLDApplications	PCI SYS Board	ACEX
PLDApplications	PC104+ SYS Board	APEX
PLDApplications	PCI20K-PROD Board	APEX
Plextek Ltd	High-Performance Signal Processing Card	Excalibur
Princeton Technology Group	Thunderbolt	Cyclone
Princeton Technology Group	Megalogic Apex2A15	APEX II
Princeton Technology Group	Megalogic 220 LVDS	APEX
Princeton Technology Group	Megalogic System 40	APEX
Rapid Technology	Rapid Technology PMC-Stratix	Stratix
Rapid Technology	Rapid Technology Stratix High-Speed Development Kit	Stratix
Rapid Technology	Rapid Technology ACEX Development Kit	ACEX
Rowe Engineering	Q5V4 Series FPGA Development Boards	Stratix
Rowe Engineering	Rowe Q4 Series FPGA	APEX
SBS Technologies	Tsunami PCI-Based Image Processing Solution	Stratix
Tensilica	XT1000	APEX

Check for the latest development kits: www.altera.com/devkits.

Table 6b. Development Kit Partner Contacts			
PARTNER	ADDRESS	TELEPHONE	EMAIL/WEB
Arrow	50 Marcus Drive Melville, New York 11747, USA	(877) 237-8621	www.arrow.com
Ateme	26 Burospace - 91573 Bièvres Cx, France	33 (0) 169-358-989	products@ateme.com www.ateme.com
AleaREP	Rotselaar 38 NL-4907 LH Oosterhout, The Netherlands	31 (0) 162-490-802	marco@fpga.nl www.fpga.nl
CEPD, Inc	5485 Conestoga Ct., Suite 250 Boulder, CO 80301, USA	(303) 415-1112	inquiries@cepdinc.com www.cepdinc.com
Dallas Logic	2300 McDermott Rd. #200-305 Plano, TX 75025, USA	(972) 359-2953	requests@dallaslogic.com www.dallaslogic.com
EasyFPGA	905 Shell Blvd., #202N Foster City, CA 94404, USA	(650) 573-9114	sales@easyfpga.com www.easyfpga.com
El Camino GmbH	Landshuter Str. 1 D-84048 Mainburg, Germany	(49) 8751-8787-0	info@elca.de www.elca.de
GiDEL Limited	48 Harimon Ein Ayyala Israel 30825	(877) 830-1647	info@gidel.com www.gidel.com
Microtronix Inc	726 Third Street London, Ontario N5V 5J2, Canada	(519) 690-0091	info@microtronix.com www.microtronix.com
MJL Inc	204-5 MJL bldg Nonhyun-dong Kangnam-gu Seoul, Korea	82 (2) 6200-2000	info@mjl.com www.mjl.com
Nova Engineering	5 Circle Freeway Drive Cincinnati, OH 45246-1201, USA	(513) 860-3456	info@nova-eng.com www.nova-eng.com
Parallax Inc.	599 Menlo Drive, Suite 100 Rocklin, CA 95765, USA	(888) 512-1024	info@parallax.com www.parallax.com
PLDApplications	Europarc Pichaury A2 - 1330, rue Guillibert 13856 Aix-en-Provence Cedex 3, France	33 (0) 442-654-388 1-866-513-0362	email@plda.com www.plda.com
Plextek Ltd	London Road, Great Chesterford Essex, CB10 1NY, England	44 (0) 179-953-3200	mktg@plextek.co.uk www.plextek.com
Princeton Technology Group	1901 North Olden Avenue, Suite 40 Ewing, NJ 08618, USA	(609) 434-1066	info@ptgroupinc.com www.ptgroupinc.com
Rapid Technology	PO Box 25493 Rochester, NY 14625, USA	(888) 290-4225	info@rapid-technology.com www.rapid-technology.com
Rowe Engineering	1344 University Avenue, Suite 5000 Rochester, NY 14607, USA	(585) 244-5460	sales@roweengineering.net www.roweengineering.net
RPA Electronics Design LLC	1285 Chenango Street Binghamton, NY 13901, USA	(607) 771-0393	info@rpaeng.com www.rpaeng.com
SBS Technologies	2400 Louisiana Blvd. NE Suite 5-600 Albuquerque, NM 87110, USA	(519) 880-8228	info@sbs.com www.sbs.com
Tensilica	3255-6 Scott Blvd. Santa Clara, CA 95054, USA	(408) 873-1000 x302	sales@hq.tensilica.com www.tensilica.com

AMPP Partner Directory

Table 7 lists the Altera AMPP Partners. For the most current list of Premier AMPP, AMPP, and AMPP Software partners, visit the Altera IP MegaStore web site: www.altera.com/IPmegastore.

Table 7. AMPP Partner Directory (Part 1 of 2)			
PARTNER	ADDRESS	TELEPHONE	EMAIL/WEB
Premier AMPP Partners			
Innocor Ltd.	7 Mill Street, Suite 300 Almonte, ON, KOA 1A0, Canada	(613) 256-5339	info@innocor.com www.innocor.com
Nova Engineering	5 Circle Freeway Drive Cincinnati, OH 45246-1105, USA	(513) 860-3456	info@nova-eng.com www.nova-eng.com
PLDApplications	Europarc Pichaury A2 1330, rue Guillibert 13856 Aix-en-Provence Cedex 3, France	33(0) 442-654-388 1-866-513-0362	email@plda.com www.plda.com
AMPP Partners			
Adaptive Micro-Ware	6917 Innovation Boulevard, Fort Wayne, IN 46818, USA	(260) 489-0046	ipcores@adaptivemicro.com www.adaptivemicro.com
Aliathon	Evans Business Center, Pitreavie Court, Dunfermline, Fife KY118UU, UK	(44) 1383-737736	info@aliathon.com www.aliathon.com
Amphion	50 Malone Road Belfast, BT9 5BS, Northern Ireland	(44) 1232-664-664	info@amphion.com www.amphion.com
Barco Silex	Rue du Bosquet 7 B-1348 Louvain-la-Neuve, Belgium	(32) 10-86-403	Geert.Decorte@barco.com www.barco-silex.com
Robert Bosch GmbH	Wernerstrasse 1 D-70469 Stuttgart, Germany	(49)-(0) 711-811-33150	Marco.Wolz@de.bosch.com www.can.bosch.com
CAST, Inc.	24 White Birch Drive, Pomona, NY 10970, USA	(914) 354-4945	opencore@cast-inc.com www.cast-inc.com
Commstack, Inc.	72 Fairfax Avenue, Atherton, CA 94027, USA	(650) 701-0939	info@commstack.com www.commstack.com
Digital Core Design	Wroclawska 94, 41-902 Bytom, Poland	(48) 32-282-8266	info@dcd.com.pl www.dcd.com.pl
DCM Technologies	7501A Capitol of Texas Hwy., Suite 140, Austin, TX 78731, USA	(510) 710-7686	info@dcmtech.com www.dcmtech.com
D'crypt Pte. Ltd.	20 Ayer Rajah Crescent, #08-08, Singapore 139964	(65) 773-9016	ipcore@d-crypt.com www.d-crypt.com
Eureka Technology	4962 El Camino Real, Suite 108, Los Altos, CA 94022, USA	(415) 960-3800	info@eurekatech.com www.eurekatech.com
IFI	Kleiner Weg 3 97877 Wertheim, Germany	(49) 9342-96080	ifi@ifi-pld.de www.ifi-pld.de
Mentor Graphics	1001 Ridder Park Drive, San Jose, CA 95131, USA	(503) 685-7816	inventra_fpga@mentor.com www.mentor.com/inventra
ModelWare	10 West Bergen Place, #105, Red Bank, NJ 07701, USA	(732) 936-1808	info@modelware.com www.modelware.com
MorethanIP	An der Steinernen Bruecke 1, D-85757, Karlsfeld, Germany	(49) 81-31-333-9390	info@morethanip.com www.morethanip.com
NewLogic Technologies	Millennium Park 6, A-6890 Lustenau, Austria	(43) 5577-62000-0	info@newlogic.com www.newlogic.com

Table 7. AMPP Partner Directory (Part 2 of 2)

PARTNER	ADDRESS	TELEPHONE	EMAIL/WEB
AMPP Partners (cont.)			
NComm, Inc.	254 North Broadway, Suite 106 Salem, NH 03079, USA	(603) 893-6186	sales@ncomm.com www.ncomm.com
Nuvation	234 East Gish Road San Jose, CA 95112, USA	(408) 573-1500	ipcores@nuvation.com www.nuvation.com
Northwest Logic	2460 NE Griffin Oaks Street, Suite 1000 Hillsboro, OR 97124, USA	(503) 533-5800	ip@nwlogic.com www.nwlogic.com
SOCmagic	Shekou Cuiweiyuan, 1-203 Shenzhen, 51807, China	(86) 755-686-1129	info@socmagic.com www.socmagic.com
Tensilica, Inc.	3255-6 Scott Boulevard Santa Clara, CA 95054, USA	(408) 873-1000, x 302	sales@hq.tensilica.com www.tensilica.com
TurboConcept	1 avenue du technopole 29280 Plouzane, France	(33) 2-29-00-12-24	info@turboconcept.com www.turboconcept.com
AMPP Software Partners			
Future Software Ltd.	4300 Stevens Creek Boulevard, Suite 187 San Jose, CA 95129, USA	(408) 243 3887, x 114	info@futsoft.com www.futsoft.com
HelloSoft, Inc.	2542 South Bascom Avenue, Suite 203 Campbell, CA 95008, USA	(408) 377 0110, x 111	info@hellosoft.com www.hellosoft.com
NComm, Inc.	254 North Broadway, Suite 106 Salem, NH 03079, USA	(603) 893-6186	sales@ncomm.com www.ncomm.com

Altera IP Support & Literature

Table 8 lists the Altera IP support and literature. For AMPP Megafunction support, contact AMPP partners directly.

Table 8. Altera IP Support and Literature		
INFORMATION TYPE	USA & CANADA	ALL OTHER LOCATIONS
Technical support	www.altera.com/mysupport/	www.altera.com/mysupport/
	800-800-EPLD (3753) 7:00 a.m. to 5:00 p.m. (Pacific Time)	408-544-8767 7:00 a.m. to 5:00 p.m. (Pacific Time)
Product literature	www.altera.com	www.altera.com
Altera literature services	lit_req@altera.com	lit_req@altera.com
Non-technical customer service	800-767-3753 7:00 a.m. to 5:00 p.m. (Pacific Time)	408-544-7000 7:00 a.m. to 5:00 p.m. (Pacific Time)
FTP site	ftp.altera.com	ftp.altera.com
IP product information	www.altera.com/products/ip/ipm-index.html	www.altera.com/products/ip/ipm-index.html



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101 Innovation Drive
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www.altera.com

Altera European Headquarters
Holmers Farm Way
High Wycombe
Buckinghamshire
HP12 4XF
United Kingdom
Telephone: (44) 1 494 602 000

Altera Japan Ltd.
Shinjuku i-Land Tower 32F
6-5-1, Nishi-Shinjuku
Shinjuku-ku, Tokyo 163-1332
Japan
Telephone: (81) 3 3340 9480
www.altera.co.jp

Altera International Ltd.
2102 Tower 6
The Gateway, Harbour City
9 Canton Road
Tsimshatsui Kowloon
Hong Kong
Telephone: (852) 2945 7000