XtremeDSP™ Solutions
Selection Guide

June 2008

XtremeDSP™

XILINX®

Contents

A New Era of Signal Processing

Highest Performance FPGAs For Signal Processing

It is no accident that Xilinx FPGAs serve an increasingly vital role in the design and development of today's most demanding digital signal processing (DSP) systems. Superior performance, system-level cost- and power-efficiency, faster time to market and unrivaled flexibility are the hallmarks of FPGA-based DSP designs – value propositions that havefound increasingly appreciative reception among leaders in markets like the communi-cations industry.

Driven by the global demand for higher quality, higher bandwidth, and inexpensive wired and wireless communications of voice, computer, and video data, the number and complexity of new communications standards has grown exponentially. This is due in large part to the need for interoperability and data exchange across myriad layers of legacy and next-generation networks. Keeping pace with these standards and the extremely critical price/performance/power ratios they pose has been anything but trivial for system vendors. Nonetheless, the flux continues to produce opportunities for industrious innovators willing to tackle the challenge.

In the dynamic markets served by high-performance DSP solutions, the inherent flexibility of the FPGA equates to:

- Faster time to market with leading-edge algorithmic-solutions and standards implementations
- Easy-to-perform in situ remote adaptation to unfore seenenvironmental and functional changes (and therefore reduced operational costs)
- Extended life cycles for existing designs (and therefor-ereduced capital expenditures)
- The perfect platform for innovative product design and migration to keep pace with changing customer demands and market requirements

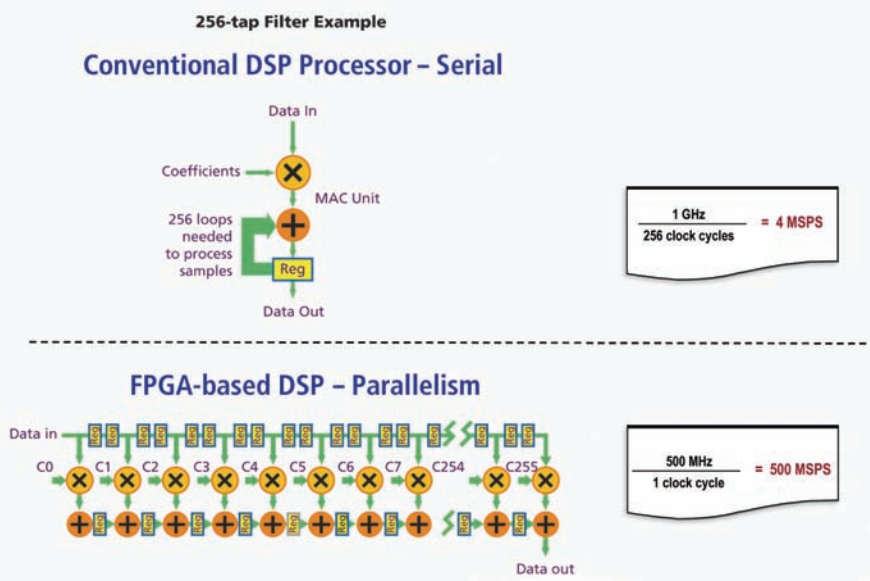
Why use FPGAs for Signal Processing?

There are five main benefits of using FPGAs for DSP applications.

1. **Ability to handle very high computational workloads** – FPGAs allow you to build highly parallel architectures thereby allowing your sample rate to equal your clock rate. The benefit is systems with performance levels up to 500MSPS. This level of performance is ideal for building very fast single channel systems or slower rate systems that comprise hundreds of channels.
2. **Offload compute intensive tasks from your DSP processor** and save valuable cycles for implementing other functions.
3. **Customize your architecture to suit your ideal algorithm** – With FPGAs you have an array of MACs or multipliers to implement single or multi-tap architectures. The reconfigurable nature of FPGAs means that once you have developed your algorithm, you can construct the ideal architecture to implement the algorithm.
4. **Reduce system cost** – FPGAs allow you to integrate other components you will need in your system and hence reduce the overall system cost. Examples include Serial RapidIO transceivers, PCI Express interfaces, glue logic and low rate control tasks.
5. **Power Efficiency** – FPGAs deliver lowest power for high sample rate per GMAC. This will enable you to reduce Op-Ex cost of the system.

Why FPGAs for DSP?

High Computational Workloads



"Today, FPGAs play an increasing role in a wide range of DSP applications. We expect this trend to continue over the next several years".

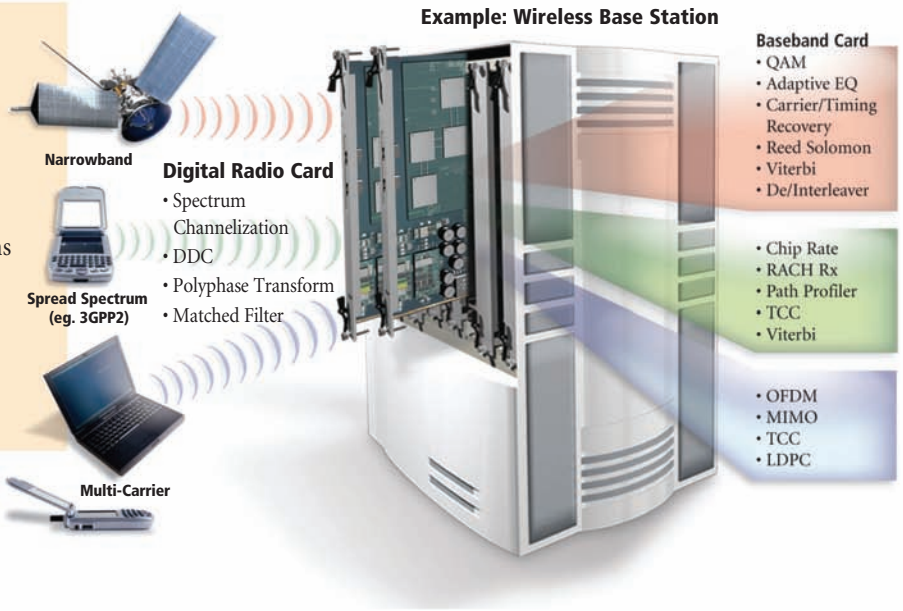
BDTI's Analysis in their report "FPGAs for DSP"

Digital Communications

Wireless/Wired Communication Systems Overview

Target Applications

- 3G/4G Base Stations
- Software Defined Radio
- Smart Antenna Systems
- Telecoms Infrastructure
- Satellite Broadcasting Systems
- Digital Audio Broadcasting
- Digital Video Broadcasting
- Fixed/mobile Wireless Broadband



Use the new XtremeDSP slices to efficiently implement:

- Digital Radio Functions
- Baseband Functions

XtremeDSP slices are used in the receive path (shown adjacent) and the transmit path for corresponding transmit functions

DSP for Digital Communications
Xilinx FPGAs are widely used for performing signal processing tasks in digital communication systems. The diagram above demonstrates some of these applications.

Wireless/Wired Communication Systems Overview

Wireless communication is experiencing rapid growth world-wide. Channel bandwidth and power constraints, coupled with the requirement for high data-rate transmission are driving system designers to employ increasingly sophisticated signal processing techniques to keep pace. These techniques require the need for very high performance signal processing resources to deal with transporting and processing digital information such as compressed speech, audio, image and video reliably from a transmit source to receivers.

Digital communications systems employ various transmission schemes based on the transmission media, available bandwidth, required bit-error-rate and communication latency. Xilinx FPGAs' ability to process sample rates in the hundreds of mega samples per second range provide the signal processing capability necessary to efficiently meet the demands of many RF and IF functions in narrow band, spread spectrum and multi-carrier systems.

The Xilinx XtremeDSP IP portfolio for digital communications provides a rich set of algorithms to support the development of today's advanced digital communication systems. For such systems, Xilinx FPGAs allow the integration of multiple channels on a single device to reduce BOM cost and drive up channel density while reducing power per channel.

The reconfigurable nature of Xilinx FPGAs also allows developers to future-proof designs through in-field upgradeability, and save thousands of dollars in maintenance costs.

High performance signal processing, flexibility and upgradeability make FPGAs the ideal choice for today's wireless and wired infrastructure applications.

Xilinx DSP Benefits for Digital Communications

- Solutions capable of handling sample rates in radio, IF and base band stages of transmit and receive chains
- Multi-channel support available on one chip, with parameterizable IP cores supporting digital communication readily available
- Very low power and cost per channel
- Low risk through reprogrammability that provides flexibility for faster time-to-market and longer time-in-market

DSP Algorithms for Digital Communications

The Xilinx CORE Generator™ system generates parameterizable algorithms (delivered as fully supported IP cores) that are optimized for Xilinx FPGAs. Exploiting these parameters allows you to make tradeoffs between performance and silicon area so that you can develop the ideal architecture to suit your algorithms. Use the Xilinx CORE Generator to design high-density designs in Xilinx FPGAs and achieve high performance results while also cutting your design time. The Xilinx CORE Generator system is included in the ISE™ Foundation™ Design Tool and comes with an extensive library of Xilinx LogiCORE™ IP. These include DSP functions, memories, storage elements, math functions and a variety of basic elements. Evaluation versions of more complex system level cores, which can be purchased separately, are also included. Use Xilinx IP to accelerate your time to market with pre-verified IP core functions optimized by expert designers.

AllianceCORE™ products are intellectual property (IP) cores that are developed, sold and supported by our third-party Global Alliance Partners. AllianceCORE certification provides a showcase for the most popular IP cores offered.

Communication IP	LogiCORE	AllianceCORE	Vendor
Filters			
FIR Filter Compiler	✔		
Cascaded Integrator Comb (CIC)	✔		
MAC FIR Filter	✔		
FIR Filter using DPRAM		✔	eInfochips Inc.
FIR Filter, Parallel Distributed Arithmetic		✔	eInfochips Inc.
Building Blocks			
Complex Multiplier	✔		
CORDIC	✔		
Multiplier Accumulator	✔		
Multiply Generator	✔		
Pipelined Divider	✔		
Sine Cosine Look Up Table	✔		
Transform			
FFT up to 64K point	✔		
FFT, Pipelined (Vectis-QuadSpeed)		✔	RF Engines, Ltd.
FFT, Pipelined (Vectis HiSpeed)		✔	RF Engines, Ltd.
Modulation/Demodulation			
Digital Down Converter (DDC)	✔		
Digital Up Converter (DUC)	✔		
Direct Digital Synthesizer	✔		
Digital Down Converter, High-Speed Wideband (4954-422)		✔	Pentek, Inc.
Digital Down Converter, Wideband (4954-421)		✔	Pentek, Inc.
DVB Satellite Modulator (MC-XIL-DVBMOD)		✔	Avnet
Compression			
1-D Discrete Cosine Transform	✔		
2-D Discrete Cosine Transform (DCT)	✔		
ADPCM, 1024 Channel Simplex (CS4190)		✔	Amphion Semiconductor, Ltd.
ADPCM, 128 Simplex (CS4125)		✔	Amphion Semiconductor, Ltd.
ADPCM, 16 Simplex (CS4110)		✔	Amphion Semiconductor, Ltd.
ADPCM, 256 Channel Simplex (CS4130)		✔	Amphion Semiconductor, Ltd.
ADPCM, 512 Channel Duplex (CS4180)		✔	Amphion Semiconductor, Ltd.
Discrete Cosine Transform (eDCT)		✔	eInfochips Inc.
Discrete Cosine Transform, 2D Inverse (IDCT)		✔	CAST, Inc.
Discrete Cosine Transform, Combined 2D Forward/Inverse (DCT_FI)		✔	CAST, Inc.
Discrete Cosine Transform, Forward 2D (DCT)		✔	CAST, Inc.
Discrete Wavelet Transform, Combined 2D Forward/Inverse (RC_2DDWT)		✔	CAST, Inc.
Discrete Wavelet Transform, Line-based programmable forward (LB_2DFDWT)		✔	CAST, Inc.
Discrete Wavelet Transform (BA113FDWT)		✔	Barco-Silex
Discrete Cosine Transform, forward/inverse 2D (DCT/IDCT 2D)		✔	Barco-Silex
Discrete Wavelet Transform, Inverse (BA114IDWT)		✔	Barco-Silex
Radar Pulse Compression (4954-440)		✔	Pentek, Inc.

Communication IP (Cont'd)	LogiCORE	AllianceCORE	Vendor
Error Correction			
Additive White Gaussian Noise (noise source)	✔		
Convolutional Encoder	✔		
Interleaver / De-interleaver	✔		
Reed-Solomon Decoder	✔		
Reed-Solomon Encoder	✔		
Turbo Convolutional Code Decoder, CDMA2000/3GPP2	✔		
Turbo Convolutional Code Encoder, CDMA2000/3GPP2	✔		
UMTS/3GPP Turbo Convolutional Decoder	✔		
UMTS/3GPP Turbo Convolutional Encoder	✔		
IEEE 802.16 TPC Encoder	✔		
IEEE 802.16 TPC Decoder	✔		
IEEE 802.16 CTC Encoder	✔		
IEEE 802.16 CTC Decoder	✔		
Viterbi Decoder	✔		
Viterbi Decoder, (IEEE 802-Compatible)	✔		
Reed Solomon Decoder (MC-XIL-RSDEC)		✔	Avnet
Reed Solomon Encoder (MC-XIL-RSENC)		✔	Avnet
Turbo Decoder, 3GPP		✔	SysOnChip, Inc.
Turbo Decoder, 3GPP (S3000)		✔	iCoding Technology, Inc.
Turbo Decoder, DVB-RCS (S2000)		✔	iCoding Technology, Inc.
Turbo Decoder, DVB-RCS (TC1000)		✔	TurboConcept
Turbo Encoder, DVB-RCS (S2001)		✔	iCoding Technology, Inc.
Turbo Product Code Decoder, 160 Mbps (TC3404)		✔	TurboConcept
Turbo Product Code Decoder, 25 Mbps (TC3000)		✔	TurboConcept
Turbo Product Code Decoder, 30 Mbps (TC3401)		✔	TurboConcept
DVB-S.2 Forward Error Correction Encoder	✔		
Cable Modem			
183 Universal Modulator Annex A/C		✔	Multi Video Designs
183 Universal Modulator Annex B		✔	Multi Video Designs
Arithmetic			
Floating-Point Operator	✔		

The Xilinx CORE Generator is included in the ISE Foundation Design Tool and comes with an extensive library of Xilinx LogiCORE IP.

CORE Generator software can be accessed from DSP design tools such as System Generator for DSP.

Reference Design Matrix

Xilinx also provides "unsupported" reference designs to help developers and innovators implement solutions and test concepts. Reference designs are delivered in multiple formats such as System Generator models or netlists.

Digital Communication Reference Designs	Xilinx	Alliance Partners	Vendor
Wireless			
Open Base Station Architecture Initiative (OBSAI) RP3	✔		
Common Public Radio Interface (CPRI)	✔		
External Memory Interface (EMIF)	✔		
Random Access Channel (RACH)	✔		
Searcher	✔		
High Speed Downlink Packet Access (HSDPA)	✔		
HSDPA-Symbol Rate HS-DSCH	✔		
Crest Factor Reduction (UMTS)	✔		
Digital Up Conversion (DUC)	✔		
Digital Down Conversion (DDC)	✔		
WCDMA/WiMax		✔	Axis Network Tech.
Wired			
MultiBERT	✔		
Gigabit System	✔		
Queue Manager	✔		
Ethernet Aggregation	✔		
Mesh Fabric	✔		

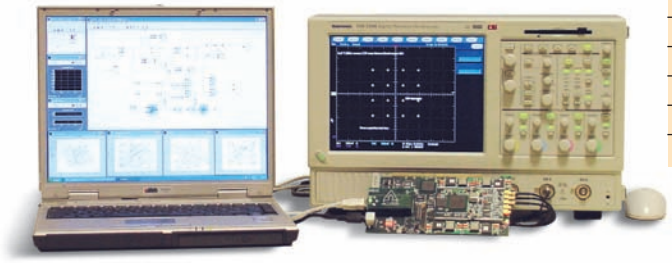
Wireless/Wired Application Notes

Jump start your design with Xilinx application notes that describe specific design examples and methodologies. These application notes prove very helpful in saving valuable time in the design process allowing you to concentrate on differentiating your product in the marketplace.

Application Note	Literature Number
CDMA2000 and UMTS DUC/DDC implementations for Spartan3/3E	XAPP569
WCDMA Reference Design	XAPP921c
Implementing an ADSL to USB Interface Using Spartan Devices	XAPP171
Common Switch Interface CSIX-L1 Reference Design	XAPP289
Implementing an ISDN PCMCIA Modem Using Spartan Devices	XAPP170
CDMA Matched Filter Implementation in Virtex Devices	XAPP212
Configurable LocalLink CRC Reference Design	XAPP562
Mixed-Version IP Router (MIR)	XAPP655
LFSRs as Functional Blocks in Wireless Applications	XAPP220
Digital Up and Down Converters for the CDMA2000 and UMTS Base Stations	XAPP569
High-Speed DES and Triple DES Encryptor/Decryptor	XAPP270
Mesh Fabric Reference Design	XAPP698
MultiBERT IP Toolkit for Serial Backplane Signal Integrity Validation	XAPP537
Queue Manager Reference Design	XAPP511
SONET Rate Conversion in Virtex-II Pro Devices	XAPP649
SONET and OTN Scramblers/Descramblers	XAPP651
Word Alignment and SONET/SDH Deframing	XAPP652
Dynamic Reconfiguration of RocketIO MGT Attributes	XAPP660
RocketIO Transceiver Bit-Error Rate Tester	XAPP661
In-Circuit Partial Reconfiguration of RocketIO Attributes	XAPP662
An Overview of Multiple CAM Designs in Virtex Family Devices	XAPP201
Content Addressable Memory (CAM) in ATM Applications	XAPP202
Designing Flexible, Fast CAMs with Virtex Family FPGAs	XAPP203
Using Block RAM for High Performance Read/Write CAMs	XAPP204
High Performance TCP/IP on Xilinx FPGA Devices Using the Treck Embedded TCP/IP Stack	XAPP546
Virtex-II SiberBridge	XAPP254
High Performance Multi-Port Memory Controller	XAPP535
Gigabit System Reference Design	XAPP536
644-Mhz SDR LVDS Transmitter/Receiver	XAPP622
FPGA Interface to the TMSC6000 DSP Platform Using EMIF	XAPP753
Gigabit Ethernet Aggregation to SPI-4.2 with Optional GFP-F Adaptation	XAPP695
Configurable Physical Coding Sublayer	XAPP759
PN Generators Using the SRL Macro	XAPP211
Hardware Acceleration of 3GPP Turbo Encoder/Decoder BER Measurement Using System Generator	XAPP948
PowerPC Processor with Floating Point Unit for Virtex-4 FX Devices	XAPP547
Continuously Variable Fractional Rate Decimator – Under Literature Column	XAPP936

XtremeDSP Development Kit with System Generator for DSP

Developed in collaboration with Nallatech, the FPGA computing solutions company, the XtremeDSP Development Kit provides a complete platform for high-performance signal processing applications such as Software Defined Radio, 3G Wireless, etc. The development board works seamlessly with the Xilinx System Generator for DSP tool and allows you to perform hardware-in-the-loop co-simulation so that you can verify your design running on the FPGA itself. Interface to the PC is via PCI bus allowing for high bandwidth co-simulation.



Hardware and Software Development Tools

Xilinx has a wide range of development tools available that enable quick movement through the DSP-based application design process. These development tools are designed to enable developers and innovators to bring new products to market fast and turn ideas into reality.

Description	Part Number
Hardware Development Tools	
HW-AFX-FF672-300 Proto Board	HW-AFX-FF672-300
HW-AFX-FF1152-300 Proto Board	HW-AFX-FF1152-300
XtremeDSP Development Kit for Virtex-4	DO-DI-DSP-DK4
XtremeDSP Development Kit for Virtex-II Pro	DO-DI-DSP-DK2PRO
Virtex-II Pro ML300 Evaluation Platform	DO-V2P-ML300
Virtex-4 ML403 Embedded Platform	HW-V4-ML403
Virtex-4 ML402 SX XtremeDSP Evaluation Platform	HW-V4-ML402
Virtex-4 ML461 Advanced memory Development System	HW-V4-ML461
Spartan-3 Starter Kit	DO-SPAR3-DK
2VP50 PICMG ATCA Design Kit	ADS-XLX-ATCA-DEVP50
2VP70 PICMG ATCA Design Kit	ADS-XLX-ATCA-DEVP70
JTAG Emulators	
Parallel Cable IV	HW-PC4
Platform Cable USB	HW-USB
Software Development Tools	
ISE Foundation	
System Generator for DSP	DS-SYSGEN-4SL-PC
2VP70 PICMG ATCA Design Kit	ADS-XLX-ATCA-DEVP50
AccelDSP Synthesis	
Development Option, AccelDSP Synthesis	DO-ACDSP-F-PC
Development Option, AccelWare Communications Toolkit	DO-AWCMT-F-PC
Development Option, AccelWare Advanced Math Toolkit	DO-AWAMT-F-PC
Development Option, AccelDSP Synthesis with AccelWare DSP IP Toolkits	DO-ACALL-F-PC

Multimedia Video and Imaging (MVI)

MVI Systems Overview

Target Applications

- AV Professional Broadcast
- Medical Imaging
- IP TV set-top boxes
- Home media gateways
- Video on Demand servers
- Multi-channel digital video recorder (DVR)
- Video conference gateways
- Digital TV and servers head-ends
- Set-top boxes
- Video surveillance
- IP-based Video conferencing end-points and server
- Video Streaming

Digital Video Systems Overview

The MVI market is enjoying enormous growth as video and imaging technologies are becoming pervasive in all aspects of life. From digital TV to video conferencing to video on mobile phones, MVI technologies are enabling new applications everywhere. The growth is fuelled by the emergence of new compression and encryption standards which make it possible to securely transmit video from producer to consumer over broadband or wireless services. These new standards come at a price however. The new generation of CODECs require vastly more processing power than the existing legacy systems and constantly evolving standards increase the risk of product obsolescence. Xilinx FPGAs provide the DSP performance needed to address these markets within a future proof programmable architecture.

For example, the Virtex™-5 SXT platform can perform up to 352 GMACs, which enables it to perform high quality/definition and multi-channel digital video system.

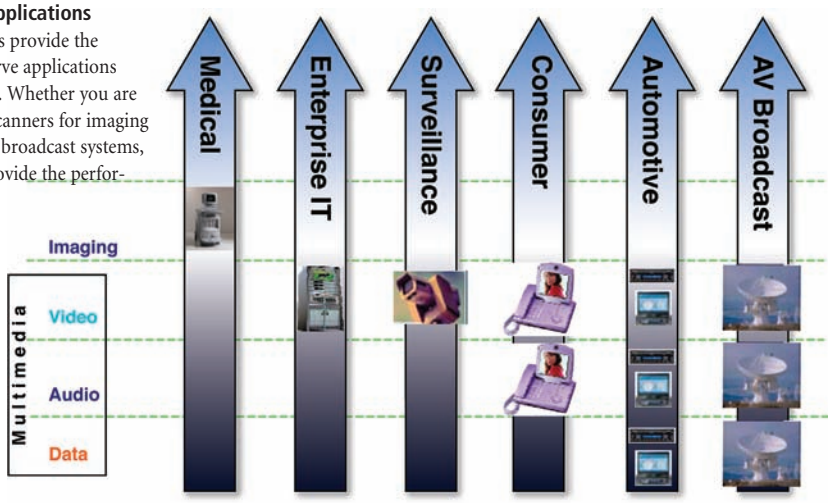
Performance and flexibility allow developers to future-proof designs now, to meet the challenges of the future simply as well as opportunities to beat competition to market.

Xilinx offers a number of products including hardware, IP and integrated system solutions that are perfect for digital video applications. Numerous hardware boards are available to get you jump started. These boards allow you to create designs even before the actual hardware board is ready. In addition, these boards provide the flexibility to upgrade evolving digital video standards during field test and reduce the development time.

Video Frame Buffer Controller

Xilinx provides a Video Frame Buffer Controller (VFBC) core that can be used in video applications where the hardware control of 2D data is needed to achieve real time operation. This is typical of motion estimation, video scaling, on-screen displays and video capture used in video surveillance, video conferencing and video broadcast.

DSP for MVI Applications
MVI technologies provide the foundation to serve applications in many markets. Whether you are designing CAT scanners for imaging or head-ends for broadcast systems, Xilinx FPGAs provide the performance you need.



Xilinx DSP Benefits for MVI Applications

- Solutions capable of handling high performance needed for real-time video applications. Examples include high definition encoding, multiple video streaming channels and support for very high frame rates
- Very low power and cost per channel
- Low risk through reprogrammability that provides flexibility for faster time-to-market and longer time-in-market
- Product differentiation through integrating other system features such as SDI interfaces for broadcast and Serial Rapid IO

MVI DSP Algorithms

The Xilinx CORE Generator software generates parameterizable algorithms (delivered as IP cores) that are optimized for Xilinx FPGAs. Exploiting these parameters allows you to make tradeoffs between performance and silicon area so that you can develop the ideal architecture to suit your algorithms. Use the Xilinx CORE Generator to design high-density designs in Xilinx FPGAs and achieve high-performance results while also cutting your design time.

The Xilinx CORE Generator system is included in the ISE Foundation Design Tool and comes with an extensive library of Xilinx LogiCORE IP. These include DSP functions, memories, storage elements, math functions and a variety of basic elements. Evaluation versions of more complex system level cores, which can be purchased separately, are also included. Use Xilinx IP to accelerate your time to market with pre-verified IP core functions optimized by expert designers.

AllianceCORE products are intellectual property (IP) cores that are developed, sold and supported by our third-party Global Alliance Partners. AllianceCORE certification provides a showcase for the most popular IP cores offered.

Video & Imaging IP	LogiCORE	AllianceCORE	Venue
Color Space Conversion, RGB2YCrCb		✔	CAST, Inc.
NTSC Color Separator (NTSC-COSEP)		✔	Pinpoint Solutions, Inc.
PCI to HDTV using FPGA and shared RAM		✔	Colorado Electroni Product Design, Inc.
SDVO: Next Generation High-Speed Serial Digital Video Interface		✔	ExaLinx, Inc.
UXGA Video Controller, 1600x1200		✔	Synchronous Design, Inc.
MPEG-2 HDTV I & P Encoder (DV1 HDTV)		✔	Duma Video, Inc.
MPEG-2 SDTV I & P Encoder (DV1 SDTV)		✔	Duma Video, Inc.
MPEG-2 Video Decoder (CS6651)		✔	Amphion Semiconductor, Ltd
MPEG-4 Video Compression Decoder		✔	4i2i Communications Ltd
MPEG-4 Video Compression Encoder		✔	4i2i Communications Ltd
MPEG-4 Video Compression Decoder	✔		
MPEG-4 Video Compression Encoder	✔		
MPEG-2 HD Decoder			
JPEG Encoder			
JPEG 2000 Decoder (BA111JPEG2000D)		✔	Barco-Silex
JPEG 2000 Encoder (BA112JPEG2000E)		✔	Barco-Silex
JPEG Fast Codec (JPEG_FAST_C)		✔	CAST, Inc.
JPEG 2000 Encoder (JPEG2K_E)		✔	CAST, Inc.
JPEG, Fast color image decoder (FASTJPEG C DECODER)		✔	Barco-Silex
JPEG, Fast Decoder (JPEG_FAST_D)		✔	CAST, Inc.
JPEG, Fast Encoder (JPEG_FAST_E)		✔	CAST, Inc.
JPEG, Fast gray scale image decoder (FASTJPEG BW DECODER)		✔	Barco-Silex
JPEG, Motion Codec V1.0 (CS6190)		✔	Amphion Semiconductor, Ltd
JPEG, Motion Decoder (CS6150)		✔	Amphion Semiconductor, Ltd
JPEG, Motion Encoder (CS6100)		✔	Amphion Semiconductor, Ltd
Motion JPEG Decoder (JPEG Decoder)		✔	4i2i Communications Ltd
Motion JPEG Encoder (JPEG Encoder)		✔	4i2i Communications Ltd
1-D Discrete Cosine Transform	✔		
2-D Discrete Cosine Transform	✔		
2-D Inverse Discrete Cosine Transform		✔	CAST, Inc.
Combined 2-D Forward/Inverse Discrete Cosine Transform		✔	CAST, Inc.
2-D Forward/Inverse Discrete Cosine Transform		✔	Barco-Silex
Discrete Cosine Transform (eDCT)		✔	eInfochips Inc.
Combined 2-D Forward/Inverse Discrete Wavelet Transform (RC_2DDWT)		✔	CAST, Inc.
Discrete Wavelet Transform (BA113FDWT)		✔	Barco-Silex
Discrete Wavelet Transform Inverse (BA114IDWT)		✔	Barco-Silex
Discrete Wavelet Transform Line-based programmable forward (LB 2DFDWT)		✔	CAST, Inc.
H.264 Video Compression-MPEG-4/AVC Encoding		✔	Ateme SA
Huffman Decoder (HUFFD)		✔	CAST, Inc.
Compact Video Controller		✔	Xylon d.o.o

A rich library of algorithms for MVI applications

MVI Application Notes

Jump start your design with Xilinx application notes that describe specific design examples and methodologies. These applications prove very helpful in saving valuable time in the design process allowing you to concentrate on differentiating your product in the marketplace.

Application Note	Literature Number
Serial Digital Interface (SDI) Video Encoder	XAPP298
Serial Digital Interface (SDI) Video Decoder	XAPP288
I2C Video Peripheral Loader	XAPP293
SDI : Ancillary Data & EDH Processor	XAPP299
SDI : Physical Layer Implementation	XAPP247
DVB-ASI Physical Layer Implementation	XAPP509
10 Gb/s Serial Digital Video Aggregation	XAPP543
Digital Video Test Pattern Generators	XAPP248
Virtex-EM FIR Filter for Video Applications v1.1 (10/00)	XAPP241
Efficient Math for Video in Virtex Devices	XAPP249
The Design of a Video Capture Board Using the Spartan Series	XAPP172
Color Space Conversion: YCrCb to RGB	XAPP283
Color Space Converter: RGB to YCbCr	XAPP637
DCT - Transforming Image Blocks from Spatial Domain to Transform Domain	XAPP610
IDCT - Transforming Image Blocks from Transform Domain to Spatial Domain	XAPP611
HDTV Video Pattern Generator	XAPP682
Color-Space Converter: RGB to YCrCb	XAPP930
Color-Space Converter: YCrCb to RGB	XAPP931
Chroma Resampler	XAPP932
Two-Dimensional Linear Filtering (2D FIR)	XAPP933
Video Virtual Socket Architecture	XAPP919
PowerPC Processor with Floating Point Unit for Virtex-4 Device	XAPP547

MVI White Papers

The Digital Video White Papers provide a system level overview of various end-equipment. The White papers contain supporting information to aid your development process when using Xilinx products.

White Papers
Wavelet Characteristics – What Wavelet Should I Use
Minimum Multiplicative Complexity Implementation of the 2-D DCT using Xilinx FPGAs
Multirate Filters and Wavelets: From Theory to Implementation
Filtering in the Wavelet Transform Domain
Real Time Image Rotation and Resizing Algorithms and Implementations
FPGA Implementation of Adaptive Temporal Kalman Filter for Real Time Video Filtering
FPGA Implementation of a Nonlinear Two Dimensional Fuzzy Filter
FPGA Interpolators Using Polynomial Filters
Issues on Medical Image Enhancement

MVI Systems Hardware and Software Development Tools

Xilinx has a wide range of development tools available that enable quick movement through the DSP-based application design process. These development tools are designed to enable developers and innovators to bring new products to market fast and turn ideas into reality.

Description	Part Number
Hardware Development Tools	
Virtex-II XLVDS Demonstration Board	HW-V2-XLVDS
XtremeDSP Development Kit for Virtex-4	DO-DI-DSP-DK4
Virtex-4 ML403 Embedded Platform	HW-V4-ML403
Virtex-4 ML402 SX XtremeDSP Evaluation Platform	HW-V4-ML402
Spartan-3 Starter Kit	DO-SPAR3-DK
Video co-processing Kit XEVM642	HW-XEVM642-SX35
Video Starter Kit Virtex-4SX35	HW-V4SX35-VIDEO-SK1
JTAG Emulators	
Parallel Cable IV	HW-PC4
Platform Cable USB	HW-USB
Software Development Tools	
ISE Foundation	
System Generator for DSP	DS-SYSGEN-4SL-PC
AccelChip DSP Synthesis	
Development Option, AccelDSP Synthesis	DO-ACDSP-F-PC
Development Option, AccelWare Communications Toolkit	DO-AWCMT-F-PC
Development Option, AccelWare Advanced Math Toolkit	DO-AWAMT-F-PC
Development Option, AccelDSP Synthesis with AccelWare DSP IP Toolkits	DO-ACALL-F-PC

XtremeDSP Video Starter Kit — Spartan-3A DSP Edition

The XtremeDSP Video Starter Kit — Spartan-3A Edition is a video development platform consisting of the Spartan-3A DSP 3400 Development Platform, the FMC-Video daughter card and a VGA camera. The Spartan-3A DSP 3400A development Platform, which can be purchased separately, is built around the Spartan-3A DSP XC3SD3400A device that provides 126 embedded DSP blocks for implementing high performance video processing systems and co-processors and DVI in and DVI out video ports. An FMC-Video daughter card is included and extends the video capabilities of the Spartan-3A DSP 3400A development platform to also include the following additional interfaces:

- DVI-I Input, both digital and analog
- Composite input
- S-video input
- 2 camera inputs
- Composite output
- S-video output

The Video Starter Kit includes the Xilinx design software tools Embedded Development Kit (EDK) and System Generator for DSP that can be used to create video applications without prior RTL knowledge or experience. Three reference designs and a library of video IP are provided to jumpstart the development process.

Performance Acceleration for DSP Video Processors

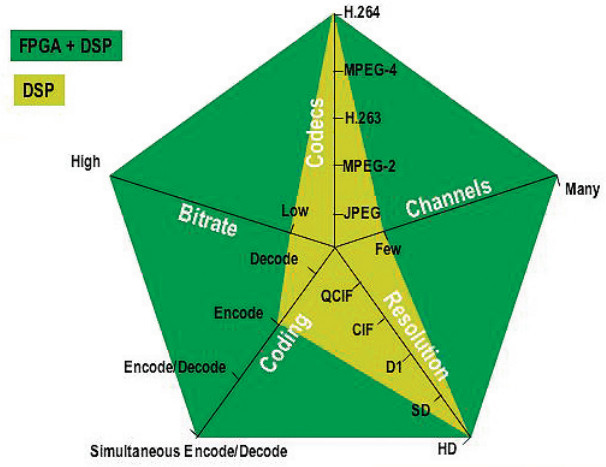
FPGAs are being used in many ways to complement DSP processors. Examples include:

- Performance acceleration in the signal chain
- Connect directly to TI DSP Processor via EMIF or serial RapidIO interface
- Consolidate system logic into FPGA
- Implement New Peripheral or bus interface using FPGA

With over 350 GMACs of horsepower, Xilinx FPGAs can also be used as pre-processors or post-processors for DSP processors like the Texas Instruments DM642.

Using an FPGA co-processor, you can enhance the capabilities of your DSP video co-processor in many ways including:

- Integrating more video channels
- Building advanced codecs (e.g. H.264)
- Increasing the resolution to support SD or HD rates
- Integrating more modes



Benefits of using FPGAs as DSP co-processors for video applications

Defense Systems

Defense Systems Overview

Target Markets

- Military Communications
- Intelligence
- Electronic Warfare
- Sensors

Target Applications

- Cognitive & Software Defined Radio
- Military Satellite Terminals
- Smart Antenna (Direction Finding/ Beam-forming)
- Communications Infrastructure
- Wideband Analysis
- Electronic Countermeasures
- Radar
- Sonar

Defense Systems Overview

Defense communication and intelligence systems are migrating from legacy stovepipe architectures to Software Defined Radios (SDR) that can be dynamically reconfigured based on mission requirements. These SDR platforms must support both legacy waveforms for voice and low-speed data as well as new wideband waveforms providing high-speed data and multimedia content. This is enabled by new and extremely fast FPGAs, such as the Virtex family, that are designed for reprogrammable, high performance, signal processing.

Phased Array Radar systems are required to perform many sophisticated signal processing tasks, including wideband digital down conversion, channel equalization, beamforming and pulse compression. While there are various silicon alternatives available for implementing these functions, such as DSP processors and General Purpose Processors (GPPs), often Xilinx FPGAs are the preferred solution due to their parallel processing ability, thereby significantly reducing system cost and power consumption.

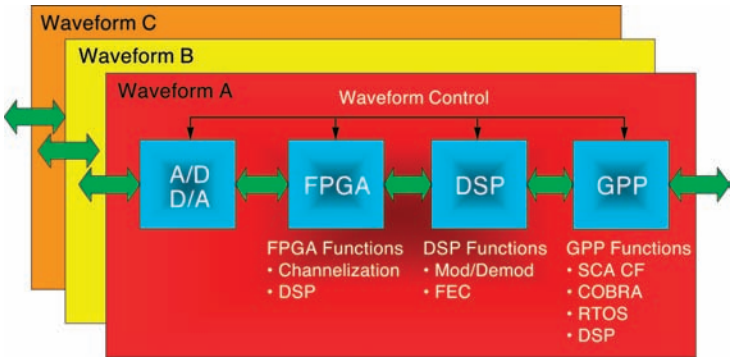
Electronics Countermeasures (EC) systems need to identify the signal of interest and jam it. These systems are required to perform wideband digital down conversion, FFTs, signal detection, and target correlation and may include electronic beam steering to optimize the jamming energy at the target receiver. Xilinx FPGAs are uniquely positioned to meet the DSP requirements demanded by EC.

With advanced process technology, Xilinx high-density Virtex-5 FPGA devices makes them low in static, dynamic and inrush power, enabling customers to design systems with smaller supply circuitry and simpler system thermal design, resulting in lower power and system cost.

Building Cost and Power Efficient SDR

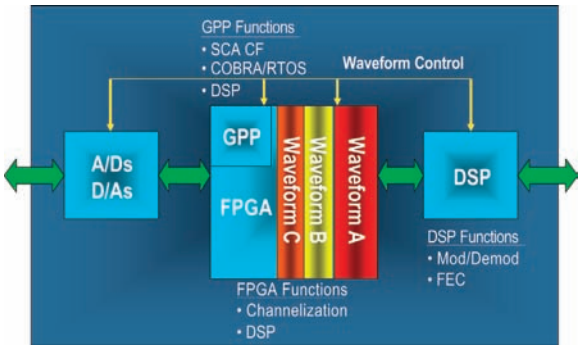
Xilinx FPGAs are commonly used in demanding applications such as software defined radio (SDR). SDR solutions require high data sample rates and channel integration, creating the need for very high-performance, yet fully programmable, digital signal processing designs that are enabled by Virtex-5, Virtex-4, and Virtex-II Pro FPGAs. With over 350 GMACs of performance, the signal processing capability of these devices are highly suitable for many of today's demanding real-time defense applications.

Xilinx has a wide range of enabling technologies that can help reduce the power consumption and cost of your system, an example of which is illustrated below.



The dedicated resources model pictured above results in:

- Higher Power Cost
- Limited Scalability



The shared resources model pictured above is a more desirable modem architecture

- Lower Power Cost
- Greater Efficiency, Scalability

The SFF SDR Development Platform

The Small Form Factor (SFF) Software-defined Radio (SDR) Development Platform is a unique new product that addresses the special portable SDR needs of military, public safety, and commercial markets. It was designed around the TI TMS320DM6446 digital media processor DSP and Xilinx Virtex-4 SX35 FPGA as a low-cost, off-the-shelf, integrated hardware and software development solution for engineers who need a SCA-compliant low power coprocessing modem development platform. This platform enables users to experiment and make educated waveform partitioning decisions based on power and performance while abstracting the complexities of of the DSP/FPGA coprocessing interface.

The SFF SDR Development Platform is separated into three distinct modules — the Digital Processing Module, Data Conversion Module, and RF Module — offering developers highly flexible development capabilities.

The SFF SDR Development Platform is part of the SFF SDR family, which also includes:

- SFF SDR Evaluation module: a limited feature version of the SFF SDR Development Platform for digital processing only, without conversion capabilities, the SCA framework, CORBA nor the model-based design kit board support package.
- SFF SCA Development Platform: SCA-enabled version of the SFF SDR Development Platform, with the first CORBA-enabled FPGA on an SCA platform.

ITAR Compliance

Xilinx compliance with International Traffic in Capital Arms Regulations (ITARs) meaning we can accept, develop and market designs and products that meet the requirements as set out in the Federal Code of Regulations. ITARs products can be handled by U.S. citizens.

Xilinx DSP Benefits for Defense Systems

With 15+ years uninterrupted experience in the Defense Industry, Xilinx understands the various dynamics and risks facing designers in the industry, including longer life cycles as well as substantial costs and loss of reputation associated with mission failure.

Xilinx's focus is on providing solutions that address your SWAPC concerns - Size, Weight, And Power, and Cost. Xilinx is combining innovative technologies, such as partial reconfiguration and SCA-enabled SoCs, with systems-level domain expertise to identify ways to reduce SWAPC in your MILCOM, Intelligence, EW, radar or sonar system.

The Xilinx XtremeDSP solution provides the performance, flexibility, productivity as well as lower costs for long life cycle applications you need. Parameterizable algorithms and third party development boards enable you to get to market quickly by using proven technologies.

Elements of the XtremeDSP Solution that are particularly suited for defense applications include:

- Advanced FPGAs for signal processing that support
  - High-sample rate applications such as multi-channel DUC/DDC for radar
  - A combination of complex and real data types
  - Integer and floating point data representations and computation
  - Low enough power for handheld and manpack wideband SDR radios
  - Partial reconfiguration that allows for more functionality to be time shared in a smaller device, thus reducing system cost and power
  - Easy and efficient support for floating point operations using 18x25 DSP48E slices (Virtex-5 only) algorithms
  - Reprogramability to reduce design risk and lower field upgrade costs
- World Class Development tools
  - Algorithms and IP cores for advanced functions such as floating point FFTs for expanding dynamic range, working in high noise environments and sensitive processing applications
  - Software tools that let you design in the language that best tackles the problem at hand. Examples include MATLAB®, Simulink®, VHDL, Verilog, RTL, C or a combination of these
  - Development platforms such as JTRS SDR kits that let you move rapidly from prototype to production

Xilinx Algorithms

The Xilinx CORE Generator software generates parameterizable algorithms (delivered as fully supported IP cores) that are optimized for Xilinx FPGAs. Exploiting these parameters allows you to make tradeoffs between performance and silicon area so that you can develop the ideal architecture to suit your algorithms. Use the Xilinx CORE Generator System to design high-density designs in Xilinx FPGAs and achieve high performance results while also cutting your design time.

The Xilinx CORE Generator system is included in the ISE Foundation Design Tool and comes with an extensive library of Xilinx LogiCORE IP. These include DSP functions, memories, storage elements, math functions and a variety of basic elements. Evaluation versions of more complex system level cores, which can be purchased separately, are also included. Use Xilinx IP to accelerate your time to market with pre-verified IP core functions optimized by expert designers.

AllianceCORE products are intellectual property (IP) cores that are developed, sold and supported by our third-party Global Alliance Partners. AllianceCORE certification provides a showcase for the most popular IP cores offered.

Defense Systems IP	LogiCORE	AllianceCORE	Vendor
Filters			
Cascaded Integrator Comb (CIC)	✔		
Distributed Arithmetic FIR Filter	✔		
MAC FIR Filter	✔		
FIR Filter using DPRAM		✔	eInfochips Inc.
FIR Filter, Parallel Distributed Arithmetic		✔	eInfochips Inc.
Building Blocks			
Complex Multiplier	✔		
CORDIC	✔		
Multiplier Accumulator	✔		
Multiply Generator	✔		
Pipelined Divider	✔		
Sine Cosine Look Up Table	✔		
Transform			
2-D Discrete Cosine Transform (DCT)	✔		
FFT up to 64K points	✔		
FFT, Pipelined (Vectis-QuadSpeed)		✔	RF Engines, Ltd.
FFT, Pipelined (Vectis HiSpeed)		✔	RF Engines, Ltd.
Modulation/Demodulation			
Digital Down Converter (DDC)	✔		
Digital Up Converter	✔		
Direct Digital Synthesizer	✔		
Digital Down Converter, High-Speed Wideband (4954-422)		✔	Pentek, Inc.
Digital Down Converter, Wideband (4954-421)		✔	Pentek, Inc.
DVB Satellite Modulator (MC-XIL-DVBMOD)		✔	Memec Design

Defense Systems IP (cont.)	LogiCORE	AllianceCORE	Vendor
Compression			
1-D Discrete Cosine Transform	✔		
2-D Discrete Cosine Transform (DCT)	✔		
ADPCM, 1024 Channel Simplex (CS4190)		✔	Amphion Semiconductor, Ltd.
ADPCM, 128 Simplex (CS4125)		✔	Amphion Semiconductor, Ltd.
ADPCM, 16 Simplex (CS4110)		✔	Amphion Semiconductor, Ltd.
ADPCM, 256 Channel Simplex (CS4130)		✔	Amphion Semiconductor, Ltd.
ADPCM, 512 Channel Duplex (CS4180)		✔	Amphion Semiconductor, Ltd.
Discrete Cosine Transform (eDCT)		✔	eInfochips Inc.
Discrete Cosine Transform, 2D Inverse (IDCT)		✔	CAST, Inc.
Discrete Cosine Transform, Combined 2D Forward/Inverse (DCT_FI)		✔	CAST, Inc.
Discrete Cosine Transform, Forward 2D (DCT)		✔	CAST, Inc.
Discrete Wavelet Transform, Combined 2D Forward/Inverse (RC_2DDWT)		✔	CAST, Inc.
Discrete Wavelet Transform, Line-based programmable forward (LB_2DFDWT)		✔	CAST, Inc.
Discrete Wavelet Transform (BA113FDWT)		✔	Barco-Silex
Discrete Cosine Transform, forward/inverse 2D (DCT/IDCT 2D)		✔	Barco-Silex
Discrete Wavelet Transform, Inverse (BA114IDWT)		✔	Barco-Silex
Radar Pulse Compression (4954-440)		✔	Pentek, Inc.
Error Correction			
Additive White Gaussian Noise	✔		
Convolutional Encoder	✔		
Interleaver / De-interleaver	✔		
Reed-Solomon Decoder	✔		
Reed-Solomon Encoder	✔		
AEHF Turbo Convolutional Code Decoder	✔		
AEHF Turbo Convolutional Code Encoder	✔		
UMTS/3GPP Turbo Convolutional Decoder	✔		
UMTS/3GPP Turbo Convolutional Encoder	✔		
IEEE 802.16 TPC Encoder	✔		
IEEE 802.16 TPC Decoder	✔		
Turbo Product Code (TPC) Decoder	✔		
Turbo Product Code (TPC) Encoder	✔		
Viterbi Decoder	✔		
Viterbi Decoder, (IEEE 802-Compatible)	✔		
Reed Solomon Decoder (MC-XIL-RSDEC)		✔	Memec Design
Reed Solomon Encoder (MC-XIL-RSENC)		✔	Memec Design
Turbo Decoder, 3GPP		✔	SysOnChip, Inc.
Turbo Decoder, 3GPP (S3000)		✔	iCoding Technology, Inc.
Turbo Decoder, DVB-RCS (S2000)		✔	iCoding Technology, Inc.
Turbo Decoder, DVB-RCS (TC1000)		✔	TurboConcept
Turbo Encoder, DVB-RCS (S2001)		✔	iCoding Technology, Inc.
Turbo Product Code Decoder, 160 Mbps (TC3404)		✔	TurboConcept
Turbo Product Code Decoder, 25 Mbps (TC3000)		✔	TurboConcept
Turbo Product Code Decoder, 30 Mbps (TC3401)		✔	TurboConcept
Arithmetic			
Floating-Point Operator	✔		

Parameterizable algorithms, and third party development boards enable you to get to market quickly by using proven technologies.

Reference Designs Matrix

Xilinx also provides unsupported reference designs to help developers and innovators implement solutions quickly. Our reference designs include the documentation you need to reproduce designs. These reference designs have been built and tested as documented.

Defense Systems Reference Designs	Xilinx	Alliance Partners	Vendor
Analog and Signal Integrity Analysis for Flight Simulator		✔	NUVATION
External Memory Interface (EMIF)	✔		
Complete Radar processing on single FPGA		✔	Dillon Engineering, Inc

Defense Systems Application Notes

Jump start your design with Xilinx application notes that describe a specific design examples and methodologies. These applications prove very helpful in saving valuable time in the design process allowing you to concentrate on differentiating your product in the marketplace.

Application Notes	Literature Number
Implementing an ADSL to USB Interface Using Spartan Devices	XAPP171
Common Switch Interface CSIX-L1 Reference Design	XAPP289
Implementing an ISDN PCMCIA Modem Using Spartan Devices	XAPP170
Gigabit System Reference Design	XAPP536
PN Generators Using the SRL Macro	XAPP211
CDMA Matched Filter Implementation in Virtex Devices	XAPP212
Configurable LocalLink CRC Reference Design	XAPP562
Gold Code Generators in Virtex Devices	XAPP217
Mixed-Version IP Router (MIR)	XAPP655
LFSRs as Functional Blocks in Wireless Applications	XAPP220
Digital Up and Down Converters for the CDMA2000 and UMTS Base Stations	XAPP569
Two Flows for Partial Reconfiguration: Module Based or Difference Based	XAPP290
FPGA Interface to the TMSC6000 DSP Platform Using EMIF	XAPP753
High –Speed DES and Triple DES Encryptor/Decryptor	XAPP270
Partial Reconfiguration	XAPP746
RLDRAMII Memory Interface for Virtex-5 FPGAs	XAPP852

Defense Systems Hardware and Software Development Tools

Xilinx has a wide range of development tools available that enable quick movement through the DSP-based application design process. These development tools are designed to enable developers and innovators to bring new products to market fast and turn ideas into reality.

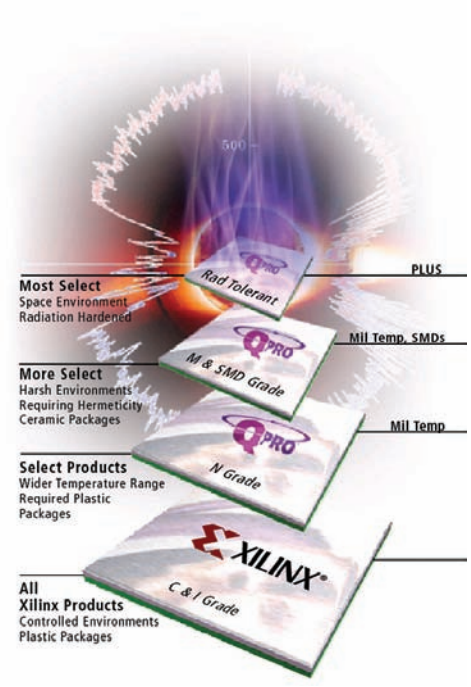
Description	Part Number
Hardware Development Tools	
XtremeDSP Development Kit for Virtex-4	DO-DI-DSP-DK4
XtremeDSP Development Kit for Virtex-II Pro	DO-DI-DSP-DK2PRO
Virtex-II Pro ML300 Evaluation Platform	DO-V2P-ML300
Virtex-4 ML403 Embedded Platform	HW-V4-ML403
Virtex-4 ML402 SX XtremeDSP Evaluation Platform	HW-V4-ML402
Virtex-5 SXT ML506 Evaluation Platform	HW-V5-ML506-UNI-G
Virtex-4 ML461 Advanced Memory Development System	HW-V4-ML461
Spartan-3 Starter Kit	DO-SPAR3-DK
XtremeDSP Development Platform – Spartan-3A DSP 3400A Edition	HW-SD3400A-DSP-DB-UNI-G
XtremeDSP Starter Platform – Spartan-3A DSP 1800A Edition	HW-SD1800A-DSP-SB-UNI-GP
JTAG Emulators	
Parallel Cable IV	HW-PC4
Platform Cable USB	HW-USB
Software Development Tools	
ISE Foundation	
System Generator for DSP	DS-SYSGEN-4SL-PC
AccelDSP Synthesis	
Development Option, AccelDSP Synthesis	DO-ACDSP-F-PC
Development Option, AccelWare Communications Toolkit	DO-AWCMT-F-PC
Development Option, AccelWare Advanced Math Toolkit	DO-AWAMT-F-PC
Development Option, AccelDSP Synthesis with AccelWare DSP IP Toolkits	DO-ACALL-F-PC

Xilinx Everywhere Product Grades

Xilinx supports the widest range of FPGAs for Aerospace and Defense in the industry. Xilinx has solutions for the challenges facing designers of aerospace and defense systems from space to base.

Xilinx offers a wide range of product grades: from commercial to Mil-Temp QPRO devices. The Xilinx QPRO family addresses the issues that are critical to the aerospace and defense market:

- QML/Best commercial practices. Commercial manufacturing strengths result in more efficient process flows
- Performance-based solutions, including cost-effective plastic packages
- Reliability of supply. Controlled mask sets and processes insure the same quality devices, every time, without variation, which remain in production for an extended time
- Off-the-shelf ASIC solutions. Standard devices readily available, no need for custom logic and gate arrays



XtremeDSP Devices

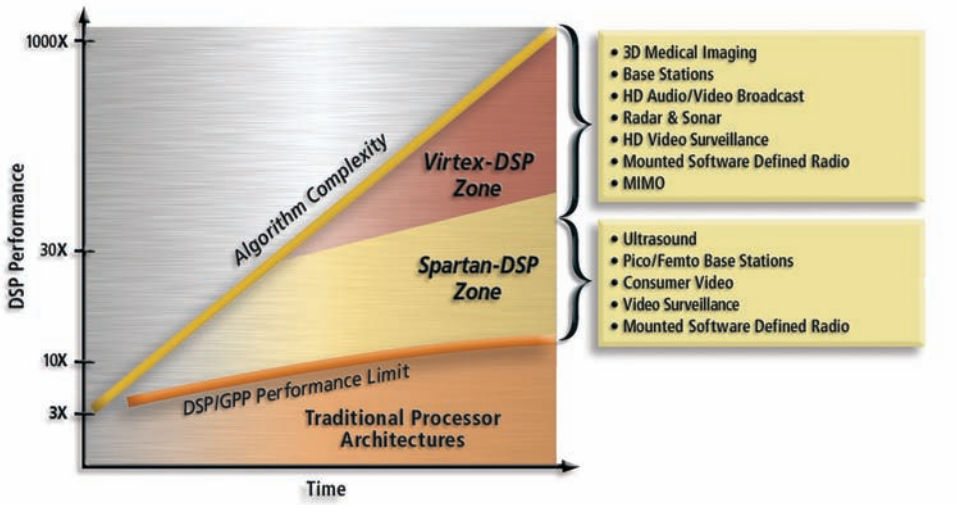
Overview

XtremeDSP Device portfolio fills the performance gap created by the growth in algorithmic complexity and limitation of sequential processors in wireless, multimedia, video imaging, and defense systems markets.

The XtremeDSP platform portfolio, comprised of two series - Virtex-DSP and Spartan-DSP, provides the range of price, performance, power efficiency, bandwidth and I/O to satisfy a broad spectrum of application requirements within the communications, MVI (multimedia, video and imaging) and Defense Systems.

Industry-Proven Highest Performance DSP

- Over 580 billion multiply-accumulate operations per second (GMAC/s)
- Parallelism with distributed memory enables sample rate to equal the clock rate - up to 550 mega samples per second (MSPS) in Virtex-5 SXT devices and 250 MSPS in Spartan-3A DSP devices (slow speed grade)
- High internal memory bandwidth - 1.5 to 19.3 Gbps (not including distributed memory)



*Algorithmic Complexity: - As demand for processing power rapidly increases, sequential processing cannot support algorithmic complexities within required response times. To overcome these architectural limitations, the parallel processing offered by XtremeDSP devices is essential.

Virtex– DSP Series

Virtex– DSP Series

Virtex-DSP series includes recently announced Virtex -5 platform based Virtex-5 SXT family of devices, and Virtex-4 platform based Virtex- 4 SX based family of devices.

Virtex-5 Platform Devices - Industry-leading Performance and Connectivity

The new XtremeDSP DSP48E slice in our flagship Virtex-5 SXT series facilitates faster and more optimized DSP functions. Virtex-5 SXT devices deliver the highest performance for performance-centric or multi-channel solutions.

The Virtex™-5 platforms meets the ultra-high digital signal processing (DSP) bandwidth and lower system-cost requirements of next-generation wireless, military/ aerospace and multi-media video applications:

- Delivers over 528 GMACs at 550 MHz with up to 1056 user-configurable DSP48E slices
- Consumes 35 percent less dynamic power as compared to previous 90-nm devices.
- Offers serial connectivity with low power transceivers that operate up to 3.2 Gbps - an industry first!
- Boosts logic performance with 65-nm ExpressFabric technology comprised of up to 95K logic cells
- Implements highly parallel architectures for astounding DSP performance with the lowest cost and power per channel for complex systems
- Incorporates up to 11.6 Mbits of embedded BlockRAM and distributed RAM for the highest memory-to-logic ratio for efficient memory-intensive functions required in video processing and medical imaging.
- Includes low-power RocketIO™ GTP transceivers (<100mW typical @ 3.2 Gbps), built-in PCI Express® endpoints and Ethernet MAC blocks
- Supports all major serial I/O protocols (PCIe®, CPRI, OBSAI, SRIO, GbE, and XAUI) to provide the lowest power solutions for building high-speed, high-bandwidth connections between chips, boards, and boxes.

Virtex-4 Devices

With up to 512 (18x18, 48-bit add) MACs each capable of operating at 500MHz, Virtex-4 FPGAs provide a 256 GMACs/s performance.

In addition with a power of only 2.3 mW per 100 MHz per DSP slice, Virtex-4 FPGAs are ideal for applications that require many channels but have an imposed power budget.

Spartan–DSP Series

Spartan-DSP series includes the new Spartan-3A DSP platform consisting of 2 devices, the 3SD3400A and the SD1800A. Each device will be offered in 2 packages – a space saving CS484 and a FG676 in both Pb and Pb-free.

Spartan-3A DSP Devices - Breakthrough Price for High-Performance DSP

The Spartan™-3A DSP device efficiently balances three critical values - price, performance, and - for a host of applications.

It targets price and power efficiency-sensitive applications such as digital front-end (DFE) and baseband solutions in a single-channel pico-cell wireless base station,military mobile software-defined radios (SDRs), ultrasound systems, driver assistance/media systems, HD video and Smart IP cameras:

- Provides up to:
  - Provides over 30 GMACS of performance enabled by up to 126 XtremeDSP DSP48A Slices in a single device.
  - Up to 2,200 Mbps memory bandwidth
  - Up to 53K logic cells
  - Robust Memory:
    - Up to 2,268 Kb of Block RAM
    - Up to 373 Kb of Distributed RAM
  - Power efficient devices

XtremeDSP Device Portfolio

	Spartan-DSP		Virtex-DSP						
	Spartan-3A DSP		Virtex-4 SX			Virtex-5 SXT			
	3SD1800A	3SD3400A	4VSX25	4VSX35	4VSX55	5VSX35T	5VSX50T	5VSX95T	5VSX240T
DSP Performance (GMACS)	21[1]	32[1]	64[2]	96[2]	256[2]	106[2]	158[2]	352[2]	580
Max Block RAM Memory Bandwidth (Gbps)	1,512[1]	2,268[1]	4,608[2]	6,912[2]	11,520[2]	6,653[2]	10,454[2]	19,325[2]	40,862
Max DSP Frequency (MHz)	250[1]	250[1]	500[2]	500[2]	500[2]	550[2]	550[2]	550[2]	500
XtremeDSP DSP48* Slices	84	126	128	192	512	192	288	640	1,056
Min Footprint (mm)	19x19	19x19	27x27	27x27	27x27	27x27	27x27	27x27	42.5x42.5
Distributed RAM (Kb)	260	373	160	240	384	520	780	1,520	4,200
Block RAM (Kb)	1,512	2,268	2,304	3,456	5,760	3,024	4,752	8,784	18,576
Logic Cells	37,440	53,712	23,040	34,560	55,296	34,816	52,224	94,208	239,616
High Speed Connectivity	227 x 622+ Mb/s LVDS pairs	213 x 622+ Mb/s LVDS pairs	120 x 1+ Gb/s LVDS pairs	224 x 1+ Gb/s LVDS pairs	360 x 1+ Gb/s LVDS pairs	180 x 1.25 Gb/s LVDS pairs, 8 x 3.2 Gb/s Transceivers	240 x 1.25 Gb/s LVDS pairs, 12 x 3.2 Gb/s Transceivers	320 x 1.25 Gb/s LVDS pairs 16 x 3.2 Gb/s Transceivers	320 x 1.25 Gb/s LVDS pairs 16 x 3.2 Gb/s Transceivers

[1] In Slow Speed Grade
[2] In Fast Speed Grade
DSP48A, DSP48E, DSP48

Virtex—DSP Series for Signal Processing Ultra High-Performance DSP

High Performance DSP

Target Applications

- Wireless Infrastructure (Smart antenna, Base-stations, Gateways)
- Wired Infrastructure (RAS, IPDSLAM, VoIP, Soft switches)
- Digital Video (Video surveillance, Video conferencing, H.264 SD/HD encode/decode)
- Imaging (Medical, Machine)
- Defense (Radar, Sonar, Military Communication Systems)

Virtex-5 Family

The Virtex-5 family of FPGAs offers a choice of four new platforms, each delivering an optimized balance of high-performance logic, serial connectivity, signal processing, and embedded processing. Three platforms are available now:

- LX Optimized for high-performance logic
- LXT Optimized for high-performance logic with low-power serial connectivity
- SXT Optimized for DSP and memory intensive applications with low-power serial connectivity .

Virtex-5 SXT Devices

The Virtex-5 SXT platform is ideal for designs that need ultra high performance DSP capability coupled with highest memory to logic ratio. The Virtex-5 SXT platform features new DSP 48E platform features new DSP48E slices that comprise 18x25 multipliers that provide expanded dynamic range and easier support for floating point operations. These new slices also feature 48-bit adders and are cascadable for building higher order filters without utilizing fabric resources. DSP48E slices also provide the best power efficiency (only 1.38 mW per 100 MHz per slice) for implementing scalable high-performance DSP structures in FPGAs.

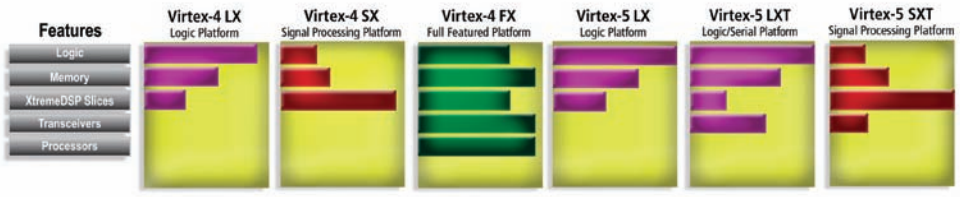
Virtex-4 SX Family

The Xilinx Virtex-4 family has revolutionizing the fundamentals of FPGA economics. With three application-domain-optimized platforms and a selection of seventeen devices, Virtex-4 FPGAs deliver breakthrough performance at the lowest cost.

The Virtex-4 SX Platform provides blazing DSP performance with unrivaled economy, with up to 512 DSP 48 slices, each capable of operating at 500 MHz throughput, for 256 GMAC/second (18x18) performance. The Xilinx XtremeDSP solution helps accelerate your products to market with state-of-the-art devices, design tools, intellectual property cores, and design services. This powerful combination gives you the fastest means of designing, verifying, and deploying your DSP algorithms and systems in FPGAs.

Virtex-4 & 5 Platforms

Based on your system requirements, choose the platform that best fits the application.



Spartan-3A DSP
Breakthrough Price for High-Performance DSP

Now Available Power Efficient Devices

Spartan-3A DSP

Breakthrough in Price for High Performance DSP

The new Spartan-3A DSP platform is ideal for cost sensitive DSP algorithmic and co-processing applications requiring significant DSP performance. The new Spartan-3A DSP platform consists of 2 devices, the 3SD3400A and the 3SD1800A. The 3SD3400A delivers over 30 GMAC/s (30 billion multiply accumulate operations per second) and up to 2,200 Mbps memory bandwidth at a volume price starting at under $45* while the 3SD1800A delivers over 20 GMAC/s for under $30* in a small-foot-print package.

Now Power Efficient

Introducing Spartan 3A DSP power efficient line of devices, these devices deliver 4.06 GMACs per mW of high performance signal processing capability to competing devices in this class. Spartan 3A DSP power efficient devices deliver a 50% static power savings, and a 70% savings while in suspend mode, compared to the non-low power devices. Dynamic power in Spartan-3A DSP devices is inherently low because of the dedicated DSP 48A slices.

This represents an unprecedented price/performance and power efficiency breakthrough that hits the mark for price and energy sensitive applications such as digital front-end (DFE) and baseband solutions in a single-channel pico-cell wireless base station, mobile tactical radios, MILCOM portable, portable medical systems, driver assistance/media systems, HD video and Smart IP cameras and motor/motion control.

*25K units/yr in late 2008

Target Applications

- Picocell /Femto Basestations
- Video Surveillance
- Consumer Video
- Milcom Portable
- Mounted Software Defined Radio

Spartan-3A DSP Product Table

	Spartan-3A DSP	
	XC3SD1800A	XC3SD3400A
XtremeDSP DSP48A Slices	84	126
Dedicated Multipliers	DSP48As	DSP48As
Block RAM Blocks	84	126
Block RAM (Kb)	1,512	2,268
Distributed RAM (Kb)	260	373
FFs/LUTs	33,280	47,744
Logic Cells	37,440	53,712
DCMs	8	8
Max Diff I/O Pairs	227	213
CS484 19x19mm (0.8mm pitch)	309	309
FG676 27x27mm (1.0mm pitch)	309	469
High Speed Connectivity	176 x 622+Mb/s LVDS pairs	208x622+ Mb/s LVDS pairs
Low Power	4.06GMACs/mW	4.06GMACs/mW

Spartan-3A DSP Hardware, IP and Software

Description	Part Number
Hardware Development Tools	
XtremeDSP Spartan-3A DSP development kit	HW-S3-DSP-SK-UNI-G
Parallel Cable IV	HW-PC4
Platform Cable USB	HW-USB
Software Development Tools	
ISE Foundation	DS-ISE-FND
AccelChip DSP Synthesis	
Development option, AccelDSP Synthesis	DO-ACDSP-F-PC
Development option, AccelWare Signal Communications Toolkit	DO-AWCMT-F-PC
Development option, AccelWare Advanced Math Toolkit	DO-AWAMT-F-PC
Development option, AccelDSP Synthesis Tool with Accelware DSP IP Toolkits	DO-ACALL-F-PC
System Generator for DSP	DS-SYSGEN-4SL-PC

Spartan-3A DSP Literature and related Technical documentation

Data Sheets	Literature Number
Spartan-3A DSP Data Sheet	DS610
User's Guides	
XtremeDSP for Spartan-3A DSP users guide	UG431
Product Brochures	
XtremeDSP Portfolio Brochure	
Spartan 3 Generation Brochure	PN 0010829 -1

XtremeDSP DSP48 Slices

Overview

High performance XtremeDSP™ DSP48 slices allow designers to implement multiple slower operations using time-multiplexing methods. They provide:

- Improved flexibility and utilization.
- Improved application efficiency.
- Reduced overall power consumption.
- Increased maximum frequency.
- Reduced set-up plus clock-to-out time.
- Support for many independent functions, including multiply, multiply accumulate (MACC), multiply add, three-input add, barrel shift, wide-bus multiplexing, magnitude comparator, bit-wise logic functions, pattern detect, and wide counter.
- Support for cascading multiple XtremeDSP DSP48 slices to form wide math functions, DSP filters, and complex arithmetic without the use of general FPGA fabric.

XtremeDSP DSP48E Slices for the Virtex-5 family:

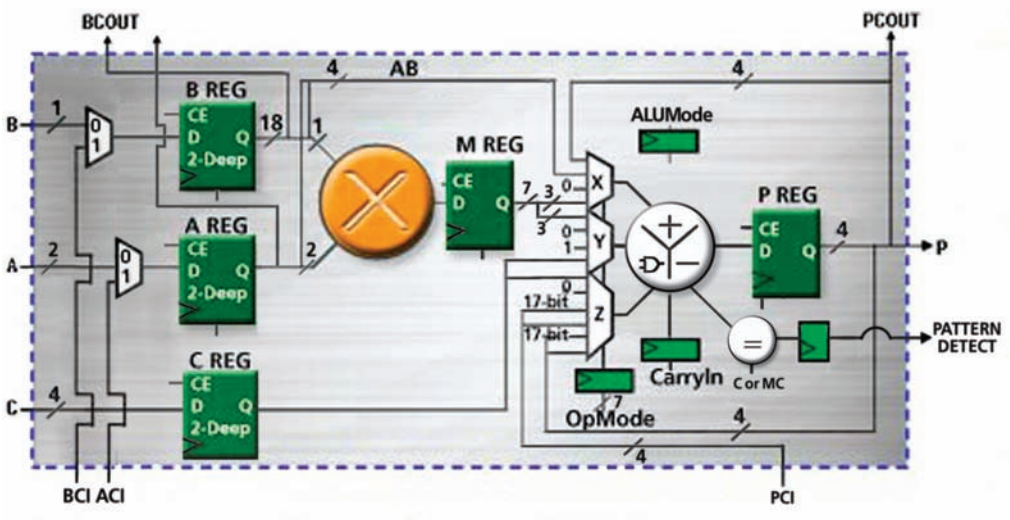
DSP48E slices, available in all Virtex™-5 devices, accelerate algorithms and enable higher levels of DSP integration and lower power consumption than previous-generation Virtex devices. They:

- Support over 40 dynamically controlled operating modes including: multiplier, multiplier-accumulator, multiplier adder/subtractor, three input adder, barrel shifter, wide bus multiplexers, wide counters, and comparators.
- Enable efficient adder-chain architectures for implementing high-performance filters and complex math efficiently.
- Draw only 1.38 mW/100 MHz at a toggle rate of 38% - a 40% reduction from prevous-generation slices.

XtremeDSP DSP48s brief comparison:

Function\Device family	XtremeDSP DSP48A	XtremeDSP DSP48	XtremeDSP DSP48E
	Spartan-3A DSP	Virtex-4	Virtex-5
Multiplier	18 x 18	18 x 18	25 x 18
Pre-adder	Yes	No	No
Cascade inputs	One	One	Two
Cascade output	Yes	Yes	Yes
Dedicated C input	Yes	No	Yes
Adder	2 input 48 bit	3 input 48 bit	3 input 48 bit
ALU logic functions	No	No	Yes
Pattern detect	No	No	Yes
SIMD ALU support	No	No	Yes
Carry signals	Carry in	Carry in	Carry in and out
RTL support	Main functions + pre-add	Main functions	Main functions

XtremeDSP DSP48E Slice



XtremeDSP DSP48 Slices for the Virtex-4 family

DSP48 slices are available in all Virtex-4 family members to accelerate algorithms and solve complex DSP challenges. They provide:

- 500MHz performance independently or when combined within a column to implement DSP functions
- 2.3 mW/100 MHz power consumption per slice, at a typical toggle rate of 38%
- Support for over 40 dynamically controlled operating modes including; multiplier, multiplier-accumulator, multiplier adder/subtracter, three input adder, barrel shifter, wide bus multiplexers, or wide counters
- DSP48 slice cascading without using device fabric or routing resources to perform wide math functions, DSP filters, and complex arithmetic

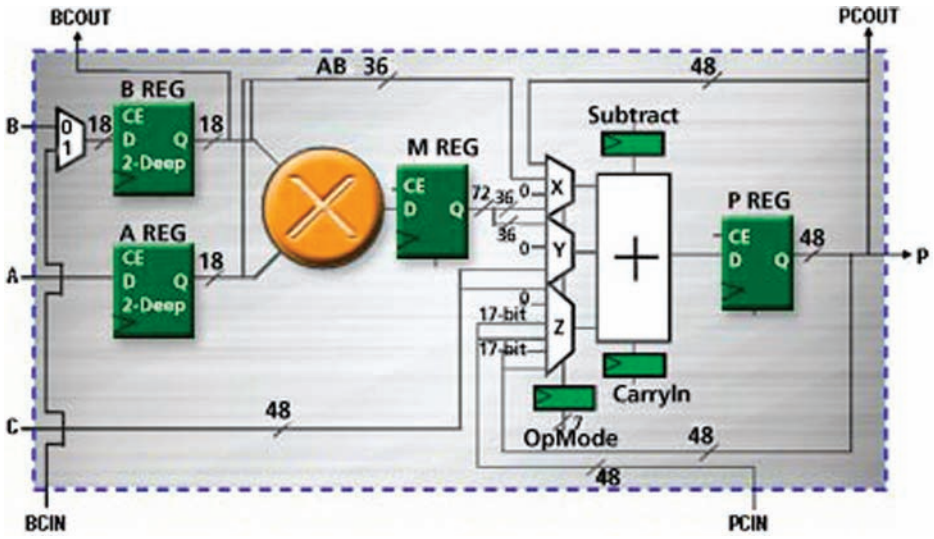
XtremeDSP DSP48 Slice Highlights

- 18-bit by 18-bit, two's complement multiplier with full precision 36-bit result, sign extended to 48 bits
- Three input, flexible 48-bit adder/subtracter with optional registered accumulation feedback
- Over 40 dynamic user-controller operating modes to adapt XtremeDSP Slice functions from clock cycle to clock cycle
- Cascading, 18-bit B bus, supporting input sample propagation
- Cascading, 48-bit P bus, supporting output propagation of partial results
- Multi-precision multiplier and arithmetic support with 17-bit operand right shift to align wide multiplier partial products (parallel or sequential multiplication)
- Symmetric intelligent rounding support for greater computational accuracy
- Performance-enhancing pipeline options for control and data signals are selectable by configuration bits
- Input port "C" typically used for multiply, add, large three-operand addition or flexible rounding mode
- Separate reset and clock enable for control and data registers

XtremeDSP DSP48E Feature Benefits

Feature	Benefit
25-bit by 18-bit, two's complement multiplier with full precision 48-bit result	Enable higher precision for greater dynamic range, single-precision floating-point math, and wide filters with fewer slices.
Enhanced second stage	Enable three input, flexible 48-bit adder/subtracter with optional registered accumulation feedback. Implement pattern detector for convergent rounding, underflow/overflow detection for saturation arithmetic, and auto-resetting counters/accumulators. Support SIMD operations.
Over 40 dynamic user-controller operating modes	Adapt DSPE slice functions from clock cycle to clock cycle.
18-bit B cascade routing	Support input sample propagation.
New 30-bit A cascade routing	Enable advanced filter implementations and reduce power.
Independent, 48-bit C input	Multiply, add, use large three-operand addition, or flexible rounding mode. Increase usability by eliminating sharing of C input across slices to simplify design and increase performance.
Cascading, 48-bit P bus	Support output propagation of partial results.

XtremeDSP DSP48 Slice



XtremeDSP DSP48A Slice for the Spartan-3A DSP family

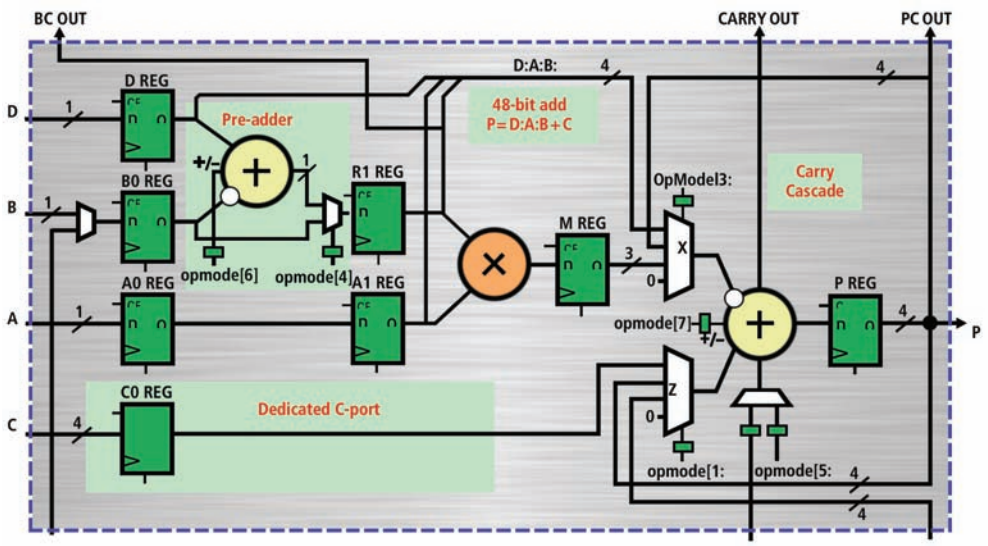
XtremeDSP DSP48A Slices for the Spartan-3A DSP family

The 250 MHZ DSP48A Slice provides an 18-bit x 18-bit multiplier, 18-bit pre-adder, 48-bit post-adder/accumulator, and cascade capabilities for various DSP applications.

XtremeDSP Slice Highlights

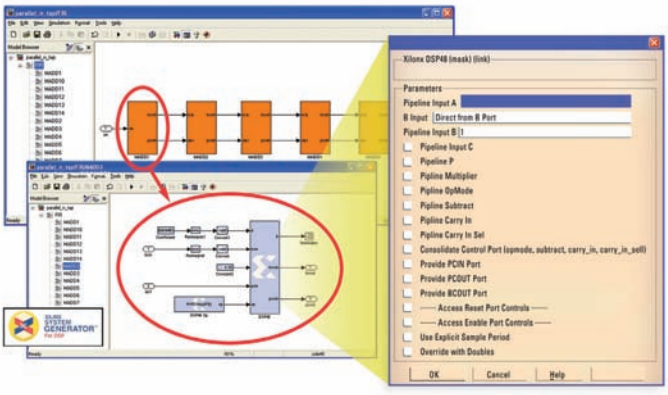
- 18-bit by 18-bit, two's complement multiplier with full precision 36-bit result, sign extended to 48 bits
- Pre-adder saves 9 logic slices per DSP48A used
- Two input, flexible 48-bit adder/subtracter with optional registered accumulation feedback
- Cascading, 18-bit B bus, supporting input sample propagation
- Cascading, 48-bit P bus, supporting output propagation of partial results
- Multi-precision multiplier and arithmetic support with 17-bit operand right shift to align wide multiplier partial products (parallel or sequential multiplication)
- Symmetric intelligent rounding support for greater computational accuracy
- Performance-enhancing pipeline options for control and data signals are selectable by configuration bits
- Input port "C" typically used for multiply, add, large three-operand addition or flexible rounding mode
- Separate reset and clock enable for control and data registers

XtremeDSP DSP48A Slice with Pre-adder



Design Optimal FIR Filters Quickly

The easiest way to implement designs to exploit the full power of the XtremeDSP Slices is to use the new FIR compiler or the Xilinx System Generator for DSP design tool. The FIR compiler will help you to optimize performance, power and cost.



Tools, Software and Support

Virtex-4 and Virtex-5 Platform Hardware and Software Development Tools

Xilinx has a wide range of development tools available that enable quick movement through the DSP-based application design process. These development tools are designed to enable developers and innovators to bring new products to market fast and turn ideas into reality.

Description	Part Number
Hardware Development Tools	
XtremeDSP Development Kit for Virtex-4	DO-DI-DSP-DK4
Virtex-5 ML506 Development Kit	HW-V5-ML506-UNI-G
Virtex-4 ML403 Embedded Platform	HW-V4-ML403
Virtex-4 ML402 SX XtremeDSP Evaluation Platform	HW-V4-ML402
JTAG Emulators	
Parallel Cable IV	HW-PC4
Platform Cable USB	HW-USB
Software Development Tools	
ISE Foundation	
System Generator for DSP	DS-SYSGEN-4SL-PC
AccelChip DSP Synthesis	
Development Option, AccelDSP Synthesis	DO-ACDSP-F-PC
Development Option, AccelWare Communications Toolkit	DO-AWCMT-F-PC
Development Option, AccelWare Signal Processing Toolkit	DO-AWSPT-F-PC
Development Option, AccelWare Advanced Math Toolkit	DO-AWAMT-F-PC
Development Option, AccelDSP Synthesis with AccelWare DSP IP Toolkits	DO-ACALL-F-PC
Development Option, AccelDSP Synthesis with AccelWare DSP IP Toolkits Evaluation	DO-ACALL-F-PC-EVAL

Virtex-5 & Virtex-4 Platform Literature and Related Technical Documentation

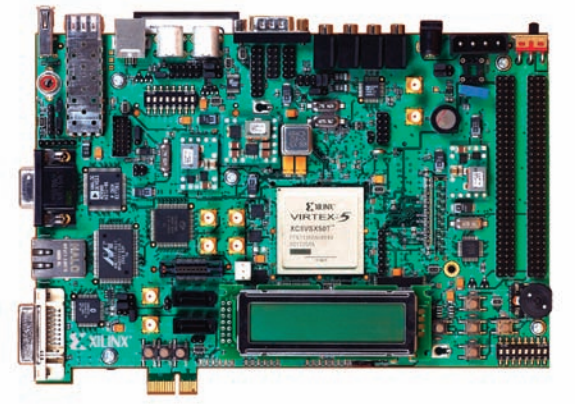
Data Sheets	Literature Number
Virtex-5 Family Overview	DS100
Virtex-5 DC and Switching Characteristics	DS202
Virtex-4 Family Overview	DS112
Virtex-4 Data Sheet: DC and Switching Characteristics	DS302
User's Guides	
Virtex-5 User Guide	UG190
Virtex-5 XtremeDSP User Guide	UG193
Virtex-5 Configuration User Guide	UG191
Virtex-5 Packaging and Pinout Specification	UG195
Virtex-5 RocketIO GTP Transceiver User Guide	UG196
Virtex-5 PCI Express Endpoint Block User Guide	UG197
Virtex-5 Embedded Tri-Mode Ethernet MAC User Guide	UG194
Virtex-5 PCB Designer's Guide	UG203
Virtex-4 User Guide	UG070
XtremeDSP Design Considerations User Guide	UG073
Virtex-4 Configuration Guide	UG071
Virtex-4 PCB Designer's Guide	UG072
Virtex-4 Packaging and Pinout Specification	UG075
Product Brochures	
Virtex-5 Brochure	pn0010938-3
Virtex-4 Brochure	pn0010798
Virtex-4 EasyPath Brochure	pn0010639
DSP Solutions	pn0010801
Virtex-4 Product Selector Guide	Virtex4_color
Application Notes	
Viterbi Decoder Block Decoding- Trellis Termination and Tail Biting	XAPP551
Single Error Correction and Double Error Detection	XAPP645
3.3V PCI Design Guidelines	XAPP653
Dynamic Phase Alignment for Networking Applications	XAPP700
Memory Interface Data Capture Using Direct Clocking Technique	XAPP701
DDR2 Controller Using Virtex-4 Devices	XAPP702
QDR II SRAM Interface	XAPP703
Virtex-4 High-Speed Single Data Rate LVDS Transceiver	XAPP704
Virtex-4 High-Speed Dual Data Rate LVDS Transceiver	XAPP705
Alpha Blending Two Data Streams Using a DSP48 DDR Technique	XAPP706
DDR SDRAM Controller Using Virtex-4 Devices	XAPP709
Synthesizable CIO DDR RLDRAM II Controller for Virtex-4 FPGAs	XAPP710
Multiple Bit Error Correction	XAPP715
Accelerated System Performance with the APU Controller and XtremeDSP Slices	XAPP717
Memory Interface Application Notes Overview	XAPP802
Leveraging "In-System ECO" Capability of Spartan-3 and Virtex-4 EasyPath FPGAs	XAPP803

Hardware Development Kits

XtremeDSP Development Kit — Virtex-5 Edition

The Development Kit includes Xilinx System Generator for DSP that can be used to create DSP designs using Simulink® from The Mathworks™ and to perform hardware-in-the-loop co-simulation so that you can verify your design running on the FPGA itself. Interface to the PC is via PCI Express interface, allowing for high bandwidth co-simulation

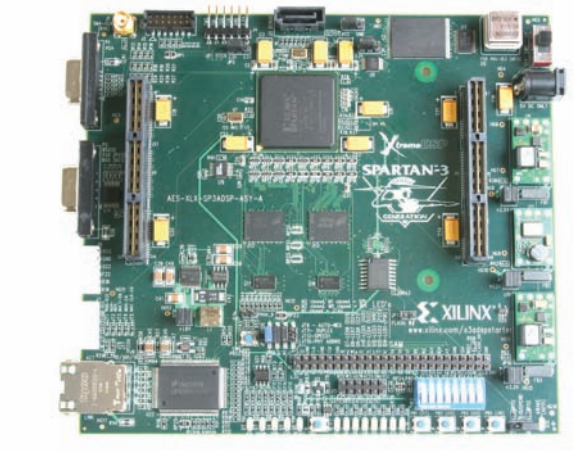
The development board works seamlessly with the Xilinx System Generator for DSP Tool and allows you to perform hardware-in the- loop co-simulation so that you can verify your design running on the FPGA itself. Interface to the PC is via PCI Express interface, allowing for high bandwidth co-simulation.



XtremeDSP Virtex-5 SXT Development Kit -ML506

XtremeDSP Starter Kit — Spartan 3A DSP 1800A Edition

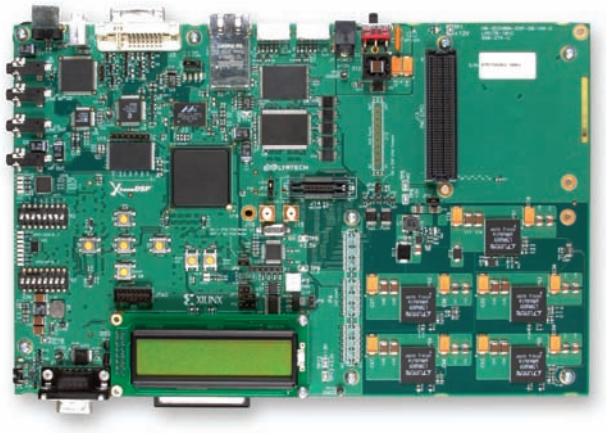
This low cost introductory design solution includes Xilinx System Generator for DSP, reference designs and ISE™ design tools supporting industry-standard peripherals, connectors and interfaces. Designed for use with the Xilinx System Generator for DSP development platform, the Spartan-3A DSP Development Platform provides a ideal environment for developing signal processing designs based on the Spartan-3A DSP device.



XtremeDSP Development Platform – Spartan-3A DSP 1800A Edition

XtremeDSP Development Platform — Spartan-3A DSP 3400A Edition

This low cost development platform is designed for use with the Xilinx System Generator for DSP and ISE™ design tools supporting industry-standard peripherals, connectors and interfaces. This platform delivers instant access to the Spartan-3A DSP family capabilities and is ideal for General Prototyping, Embedded Processing, Digital Video, DSP Co-Processing and Digital Communications applications. It was developed to help designers and system architects deal with the design challenges in a wide variety of markets including wireless, automotive, consumer, multimedia, video imaging, industrial, medical, military/aerospace, servers, storage and telecom/datacom.



XtremeDSP Starter Platform – Spartan-3A DSP 3400A Edition

Xilinx DSP Development Boards

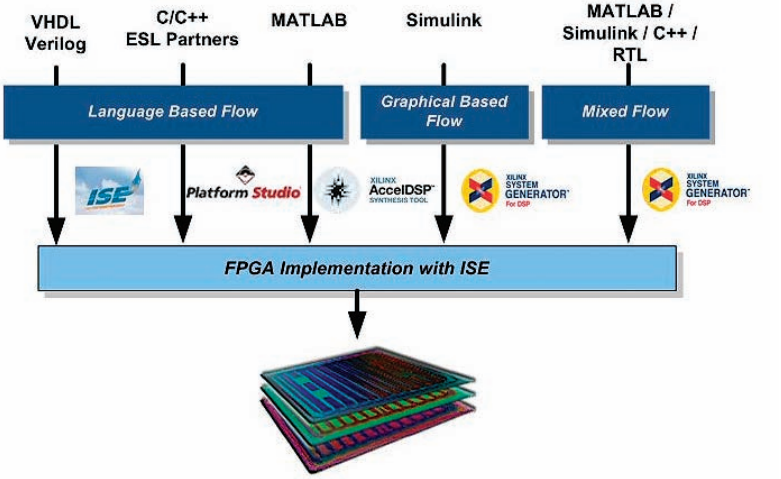
Xilinx Part Number	Tool Description	Devices Supported	Supports High Bandwidth Hardware in the Loop
Digital Communication (Wired/Wireless)			
DO-DI-DSP-DK2PRO	XtremeDSP Development Kit for Virtex-II Pro	Virtex-II Pro	✔
DO-DI-DSP-DK2PRO-SG	XtremeDSP Development Kit for Virtex-II Pro with System Generator tool	Virtex-II Pro	✔
DO-DI-DSP-DK4	XtremeDSP Development Kit for Virtex-4	Virtex-4	✔
DO-DI-DSP-DK4-SG	XtremeDSP Development Kit for Virtex-4 with System Generator tool	Virtex-4	✔
HW-AFX-FF672-300	HW-AFX-FF672-300 Proto Board	Virtex-4	
HW-AFX-FF1152-300	HW-AFX-FF1152-300 Proto Board	Virtex-4	
DO-V2P-ML300	Virtex-II Pro ML300 Evaluation Platform	Virtex-II Pro	
HW-V4-ML403	Virtex-4 ML403 Embedded Platform	Virtex-4	
HW-V4-ML402	Virtex-4 ML402 SX XtremeDSP Evaluation Platform	Virtex-4	
ADS-XLX-ATCA-DEVP50	2VP50 PICMG ATCA Design Kit	Virtex-II Pro	
ADS-XLX-ATCA-DEVP70	2VP70 PICMG ATCA Design Kit	Virtex-II Pro	
Multimedia, Video and Imaging			
HW-V2-XLVDS	Virtex-II XLVDS Demonstration Board	Virtex-II	
DO-DI-DSP-DK2PRO	XtremeDSP Development Kit for Virtex-II Pro	Virtex-II Pro	✔
DO-DI-DSP-DK2PRO-SG	XtremeDSP Development Kit for Virtex-II Pro with System Generator tool	Virtex-II Pro	✔
DO-DI-DSP-DK4	XtremeDSP Development Kit for Virtex-4	Virtex-4	✔
DO-DI-DSP-DK4-SG	XtremeDSP Development Kit for Virtex-4 with System Generator tool	Virtex-4	✔
HW-V4-ML403	Virtex-4 ML403 Embedded Platform	Virtex-4	
HW-V4-ML402	Virtex-4 ML402 SX XtremeDSP Evaluation Platform	Virtex-4	
DO-SPAR3-DK	Spartan-3 Starter Kit	Spartan-3/3E	
HW-V4SX35-VIDEO-SK	Virtex-4 Video Starter Kit	Virtex-4	
HW-X61-VIDEO	VIDEO 10 Daughter Card	Virtex-4	
Aerospace and Defense			
DO-DI-DSP-DK2PRO	XtremeDSP Development Kit for Virtex-II Pro	Virtex-II Pro	✔
DO-DI-DSP-DK2PRO-SG	XtremeDSP Development Kit for Virtex-II Pro with System Generator tool	Virtex-II Pro	✔
DO-DI-DSP-DK4	XtremeDSP Development Kit for Virtex-4	Virtex-4	✔
DO-DI-DSP-DK4-SG	XtremeDSP Development Kit for Virtex-4 with System Generator tool	Virtex-4	✔
HW-AFX-FF672-300	HW-AFX-FF672-300 Proto Board	Virtex-4	
HW-AFX-FF1152-300	HW-AFX-FF1152-300 Proto Board	Virtex-4	
DO-V2P-ML300	Virtex-II Pro ML300 Evaluation Platform	Virtex-II Pro	
HW-V4-ML403	Virtex-4 ML403 Embedded Platform	Virtex-4	
HW-V4-ML402	Virtex-4 ML402 SX XtremeDSP Evaluation Platform	Virtex-4	
General Purpose Signal Processing			
HW-V4-ML402	ML402 XtremeDSP Evaluation Platform	Virtex-4	
HW-V5-ML506-UNI-G	Virtex-5 XST Evaluation Platform	Virtex-5 SXT	
DO-SPAR3-DK	Spartan-3 Starter Kit	Spartan-3/3E	
HW-SD3400A-DSP-DB-UNI-G	XtremeDSP Development Platform – Spartan-3A DSP 3400A Edition	Spartan-3A DSP	
HW-SD1800A-DSP-SB-UNI-G	XtremeDSP Starter Platform – Spartan-3A DSP 1800A Edition	Spartan-3A DSP	

DSP Development Boards from Third-Parties

Third Parties				
Digital Communications (Wired/Wireless)				
DSP Systems	www.dspsystems.com	Virtex-II/II Pro		
Elite Innovations	www.eliteinnovations.com	Virtex 4		✔
Innovative DSP	www.innovative-dsp.com	Virtex-II/II Pro	✔	✔
Lyrtech	www.lyrtech.com	Virtex-II/II Pro and Virtex-4	✔	✔
Multiple Access Comms	www.macled.com	Virtex-II/II Pro		
Nallatech	www.nallatech.com	Virtex-II/II Pro and Virtex 4	✔	
Pentek	www.pentek.com	Virtex-II/II Pro		✔
Sundance	www.sundance.com	Virtex-II/II Pro and Virtex 4		✔
Spectrum Digital	www.spectrumdigital.com	Virtex-II/II Pro		
Spectrum Signal	www.spectrumsignal.com	Virtex-II/II Pro		✔
Traquair	www.traquair.com	Virtex-II/II Pro and Spartan-3/3E		✔
Multimedia, Video and Imaging				
Lyrtech	www.lyrtech.com	Virtex-II/II Pro	✔	✔
Sundance	www.sundance.com	Virtex-II/II Pro and Virtex 4		✔
Spectrum Digital	www.spectrumdigital.com	Virtex-II/II Pro		
Aerospace and Defense				
DSP Systems	www.dspsystems.com	Virtex-II/II Pro		
Elite Innovations	www.eliteinnovations.com	Virtex 4		✔
Innovative DSP	www.innovative-dsp.com	Virtex-II/II Pro	✔	✔
Lyrtech	www.lyrtech.com	Virtex-II/II Pro	✔	✔
Multiple Access Comms	www.macled.com	Virtex-II/II Pro		
Nallatech	www.nallatech.com	Virtex-II/II Pro and Virtex 4	✔	
Pentek	www.pentek.com	Virtex-II/II Pro		✔
Sundance	www.sundance.com	Virtex-II/II Pro and Virtex 4		✔
Spectrum Digital	www.spectrumdigital.com	Virtex-II/II Pro and Virtex-4		
Spectrum Signal	www.spectrumsignal.com	Virtex-II/II Pro		✔
Traquair	www.traquair.com	Virtex-II/II Pro and Spartan-3/3E		✔
General Purpose Signal Processing				
Alpha Data	www.alpha-data.com	Virtex-II/II Pro and Virtex 4	✔	
Annapolis Microsystems	www.annapmicro.com	Virtex-II/II Pro and Virtex-4	✔	
Anzus	www.anzus.com	Virtex-II/II Pro	✔	
Avnet	www.avnet.com	Virtex-II/II Pro, Virtex 4 and Spartan-3/3E	✔	✔
Bittware	www.bittware.com	Virtex-II/II Pro		✔
Nu Horizons	www.nu-horizons.com	Virtex-II/II Pro and Spartan-3/3E	✔	
VMETRO Transtech	www.vmetro.com	Virtex-II/II Pro	✔	

DSP Design Environment

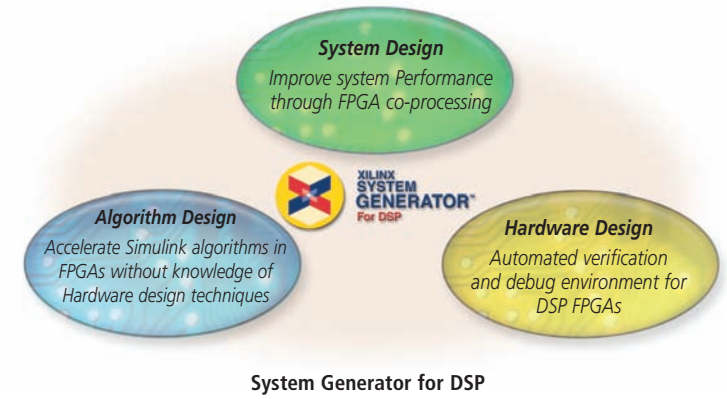
Xilinx DSP design tools accelerate system level verification using hardware prototyping and help you to increase the performance of your DSP system while lowering the cost. Algorithm, hardware and system designers each receive the benefits that FPGAs have to offer and our design tools address the unique requirements for each designer. Our DSP design philosophy is based on letting you design using the tool that best solves the problem at hand and not dictate a one-size-fits-all design flow. Whether you are designing in C/C++, MATLAB®, Simulink®, HDL or a combination of these, Xilinx offers best-in-class tools to help you get the job done both optimally and faster.



Supported DSP Design flows

System Generator for DSP™ Tool

Based on the defacto standard for Model-Based Design, Simulink from The MathWorks, Xilinx System Generator for DSP (System Generator) is an FPGA design environment that is tailored to the unique needs of system, algorithm and hardware developers designing DSP systems. Each design discipline has different skills and problems to solve. Unique feature sets within System Generator allow each developer to realize the benefits that FPGAs offer using a design methodology that is familiar and productive for them.



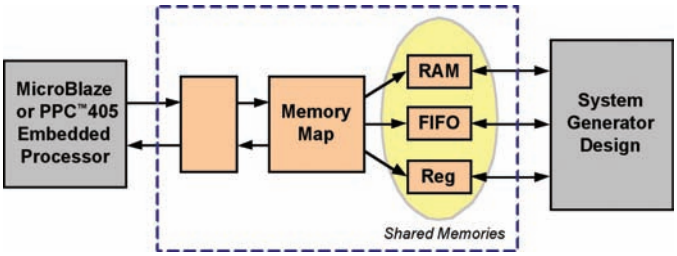
System Generator for DSP
Solving Problems for Multiple Disciplines

System Design

DSP hardware platforms, traditionally based on processors running algorithms developed in C, have been migrating towards the use of FPGA co-processors in order to increase performance while reducing power and cost. System design of this hardware involves the partitioning of the main components into software running on DSP or embedded processors and the FPGA.

Support for Embedded Processing through Shared Memories

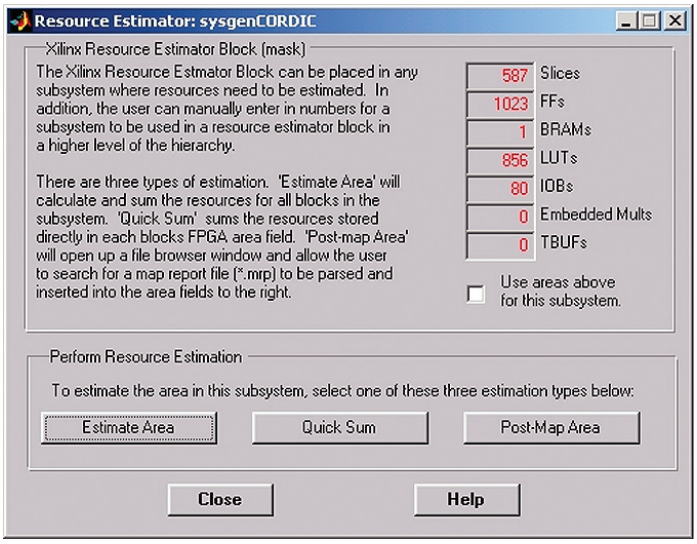
System Generator facilitates hardware/software partitioning by offering tight integration to the Xilinx Platform Studio tool for embedded processing (available through EDK, the Embedded Development Kit). A shared memory interface is available for targeting the Xilinx MicroBlaze™ embedded processor. This abstracts away the hardware implementation details for both the C programmer and DSP designer.



Shared Memory Interface to Xilinx Embedded Processors

Resource Estimation

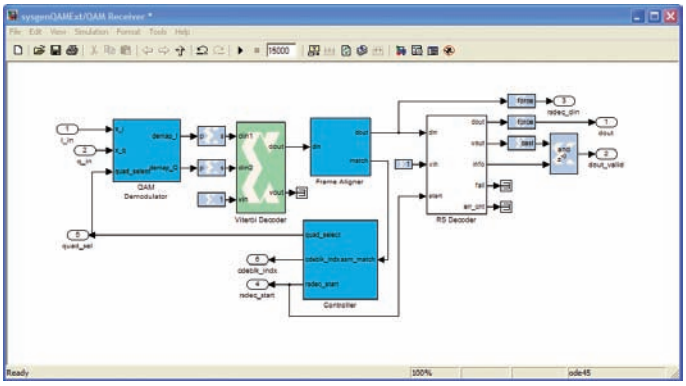
System Generator's "Resource Estimator" provides a quick FPGA resource utilization estimate prior to performing the synthesis and place and route implementation steps. These estimates can be used to guide the hardware/software partitioning process.



System Generator Resource Estimator

Algorithm Design

System Generator comes complete with an optimized, bit and cycle accurate library for assembling sophisticated signal processing systems. Xilinx algorithmic IP is an integral part of this library and is used to rapidly create efficient implementations of common DSP building blocks such as FIR filters, FFTs and forward error correction (FEC) blocks.



Using Algorithmic IP blocks in Simulink/System Generator

Design Exploration through IP Parameterization

Different hardware architectures for a DSP algorithm can be quickly explored through parameterization of the IP building blocks. Each block can be customized through a unique set of hardware implementation parameters that effect hardware features, pipelining, sample rate and resource sharing. These effects can be quickly analyzed using the Simulink cycle accurate simulation environment.

Boost Simulation Performance using Hardware Co-Simulation

Exploring and verifying mathematical approaches to system requirements, often requires test and refinement of DSP algorithms using real world data. This can result in large vector sets and the need for real-time verification performance. System Generator enables designs captured in Simulink, MATLAB, and RTL to be accelerated up to 1000x using hardware-in-the-loop co-simulation on a variety of Xilinx provided and 3rd party hardware platforms.

MATLAB Support

Floating-point MATLAB is supported for model generation, via the Xilinx AccelDSP Synthesis tool. MATLAB provides an efficient DSP modeling language through native support for vector and matrix operations and an extensive set of built-in functions. User defined DSP blocks can be generated from AccelDSP Synthesis and used within the System Generator modeling and hardware generation environment. AccelWare™ parameterized DSP IP can be used with the floating-point MATLAB for hardware representations of linear algebra operations such as adaptive filtering, matrix inversion, matrix factorization and MIMO.

Hardware Design

Hardware engineers developing production FPGAs need to maximize the performance and minimize the cost of their final implementation. For these designers VHDL or Verilog is often their design creation method of choice.

System Generator bridges a verification gap by allowing RTL models to be simulated and verified from within the Simulink DSP modeling environment. Inputs created using the Simulink standard blocksets can be used to drive the RTL simulation and outputs generated from RTL simulation can be viewed using the standard Simulink plotting functions. Hardware in the loop co-simulation is supported for this flow providing up to a 1000x simulation performance increase.

System Generator for DSP Product Features

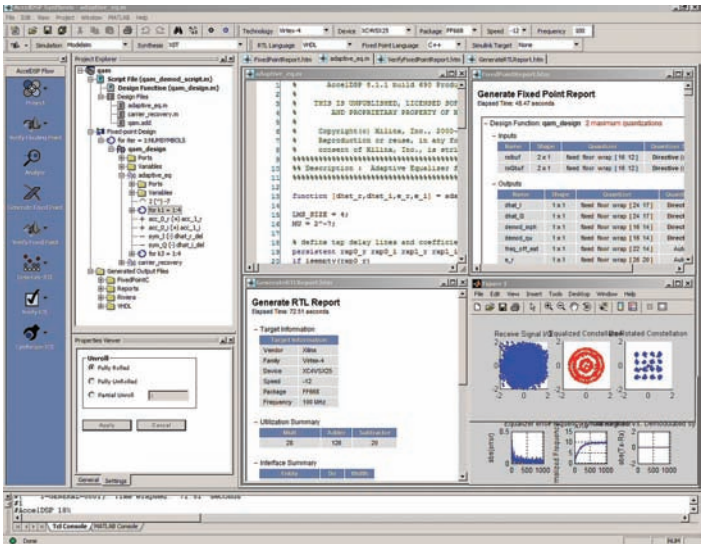
- Tight integration to the Xilinx EDK for adding embedded processors to the DSP hardware
- Fixed-point RTL generation
- FPGA resource estimation
- Integration to 3rd partly ESL C-synthesis tools
- 1000x simulation performance improvement through hardware co-simulation
- Xilinx optimized DSP blockset for Simulink MATLAB language support through AccelDSP
- FIR Filter compiler
- Black box support for VHDL and Verilog
- RTL testbench generation

Major Benefits

- Assists system designers in partitioning operations between processors and FPGA logic
- Accelerates the verification of RTL within a DSP modeling environment by up to 1000x
- Enables the use of the algorithm friendly MATLAB/ Simulink modeling environment for FPGA design

AccelDSP Synthesis Tool

The AccelDSP™ Synthesis Tool automates the generation of synthesizable RTL directly from floating point MATLAB models. A Model-Based Design environment is provided from which high-performance DSP designs can be rapidly implemented in Xilinx FPGAs through a highly productive, top-down flow integrated with third party and Xilinx design tools.



AccelDSP Synthesis Tool

Explore Multiple Design Implementations Using Single Golden Source

Algorithms written in the MATLAB language become the golden design source driving the entire AccelDSP design and verification flow. All major design tasks, from floating-point definition to gate-level implementation, are derived from the MATLAB golden source. Speed and area tradeoffs can be explored by setting system-level requirements and using the tool's IP-Explorer technology to rapidly select optimal silicon implementations of key DSP building blocks. AccelDSP reports make it easy to evaluate the effects of design changes on resource utilization, throughput and latency.

Automated Floating- to Fixed-point Generation

MATLAB algorithms must be implemented in fixed-point hardware to achieve higher performance in FPGAs. This requires the scaling and precision of each variable to be defined to avoid overflow/underflow conditions – a tedious, error-prone process.

AccelDSP Synthesis assists in this process by using the floating-point source and stimulus to determine the dynamic range of each variable and input/output port. Once determined, quantization directives are set throughout the design and a fixed-point MATLAB or C++ model is generated that is optimized for fast execution in MATLAB. These quantization values can be re-defined by the user.

Scalable and Synthesizable Cores

AccelWare™ toolkits are hardware optimized DSP IP core generators for use with AccelDSP Synthesis that provide essential signal processing components. These generators support multiple macro-architectures to let designers craft a design for the specific requirements. Toolkits are available for:

- Communications, Reed-Solomon encoding/decoding, Viterbi decoding, etc.
- Advanced Math – SVD/QR/Cholesky matrix factorization, QR & Cholesky/triangular matrix inversion, etc.

AccelWare toolkits are functionally equivalent to their MATLAB toolbox counterparts supporting the same input parameters. The hardware parameterization of AccelWare IP far exceeds that of RTL-level intellectual property, providing synthesizable cores with the flexibility to precisely meet requirements with optimal hardware.

IP-Explorer Technology for Heuristic-Driven Optimization

IP-Explorer automatically replaces standard function calls used in a MATLAB model with hardware accurate architectures from the AccelWare IP library. This process is heuristic-driven based on bit widths and system constraints such as area and performance. Statistical methods are then used to select the best

AccelWare architecture for each use of a function to produce an overall optimized design. This technology elevates hardware design to a higher abstraction increasing productivity and reducing the time to implement designs.

Optimize Hardware Implementation through Directives

AccelDSP offers a set of synthesis directives that guide decisions about resource utilization and alternative implementations that cannot be inferred from the high-level MATLAB language constructs. Supported directives include loop rolling/unrolling, quantization, matrix multiplication expansion, RAM/ROM memory mapping, pipeline insertion, and shift register mapping. Using these directives enables hardware-based design exploration without code rewrites.

Correct-by-Construction DSP Design

Developing and maintaining verification suites that check equivalency of algorithmic, RTL, and gate-level designs is a resource-intensive task that must be done to ensure that the hardware matches the original algorithm. AccelDSP automates this process by generating a simulation testbench using test vectors created from the MATLAB fixed-point simulation. AccelDSP is integrated with leading 3rd party simulation tool providers.

Generate Models for System Validation and Integration inside System Generator for DSP.

MATLAB algorithms synthesized by AccelDSP can be incorporated into larger DSP systems using Simulink. AccelDSP generates bit and cycle accurate models for use with the standard Simulink blockset or with the Xilinx DSP blockset provided as part of System Generator. This allows rapid validation of MATLAB algorithms in a hardware system through System Generator's hardware co-simulation.

The Xilinx ESL Initiative

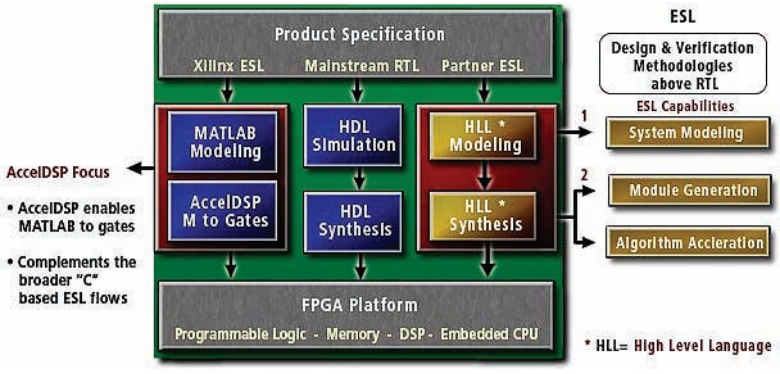
Adding an FPGA co-processor to a DSP hardware system provides new implementation options, including FPGA logic and embedded processing that can be used to dramatically increase the performance and lower the cost of the hardware system. Taking advantage of these new options, however, can be a daunting task for DSP designers accustomed to working in a C development environment. To ease the adoption of FPGA co-processors Xilinx has created the "ESL Initiative" which is a partnership between Xilinx and the industries leading providers of Electronic System Level (ESL) design solutions. Through this initiative innovative solutions are being developed to map C routines directly onto the hardware resources of the Xilinx FPGAs from a software friendly development environment.

AccelDSP Synthesis Product Features

- MATLAB-based algorithmic synthesis generates technology-optimized RTL
- Automated floating-to-fixed-point conversion
- IP-Explorer technology enables heuristic-driven selection of hardware architecture at algorithmic level
- Complete automated verification flow with automatic testbench generation
- Hardware optimizations including loop rolling/unrolling, matrix multiplication expansion, RAM/ROM memory mapping, pipeline insertion, and shift register mapping
- Model generators for Simulink and Xilinx System Generator for DSP
- Easy-to-use graphical user interface integrates with downstream tools

Major Benefits

- Single, golden source drives synthesis and verification flow for all Xilinx FPGAs,
- Provides flexibility to use both algorithmic synthesis and DSP intellectual property
- Works with MATLAB and Simulink products from The MathWorks
- Provides device neutrality
- Proven to increase productivity up to 20x



ESL Initiative Capabilities

- Includes industry-leading ESL tool providers
- Focus on C-to-FPGA design flows
- Flows Support the MicroBlaze and PowerPC 405 embedded processors
- C-to-FPGA logic flows support both module creation and hardware accelerators

Complementary Software Design Tools

System Modeling and Design

Simulink

Simulink (from The MathWorks) is a platform for multidomain simulation and Model-Based Design of dynamic systems. It provides an interactive graphical environment and a customizable set of block libraries that let you accurately model and simulate signal processing, communications, and other time-varying systems.

Platform Studio

Platform Studio (from Xilinx) is an integrated development environment containing a wide variety of embedded design tools, IP, libraries, wizards, and design generators to quickly facilitate the creation of your custom embedded platform. The tool supports all Xilinx 32 bit microprocessors and can be invoked from System Generator for DSP.

Algorithm Development

MATLAB

MATLAB (from The Mathworks) is a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numerical computation. Using MATLAB, you can solve technical computing problems faster than with traditional programming languages, such as C, C++

AccelDSP™ Synthesis Tool is a high-level MATLAB® language based tool for designing DSP blocks for Xilinx FPGAs. The tool automates floating- to fixed-point conversion, generates synthesizable VHDL or Verilog, and creates a testbench for verification. You can also generate a fixed-point C++ model or System Generator block from a MATLAB algorithm.

HDL Simulation and Generation

ISE

ISE Foundation software (from Xilinx) allows you to essentially program the FPGA. Hardware designers can design using VHDL or Verilog. When using System Generator, ISE design tools can be invoked in batch mode.

Synthesis

XST from Xilinx and Synplify Pro from Synplicity are synthesis tools that allow low cost and highly efficient mapping to Xilinx hardware, respectively. When used in conjunction with System Generator, you have the option to use these tools in batch mode.

ModelSim

If you already have legacy or production ready HDL then System Generator provides the necessary interfaces to allow you to interface to Mentor Graphics' ModelSim simulator. You can co-simulate your HDL using ModelSim and import simulated results to the Simulink/System Generator simulation in real-time.

Verification and Debug

ChipScope Pro

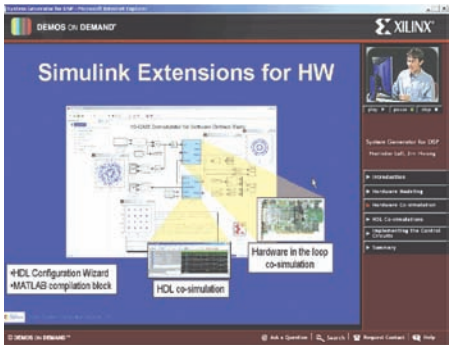
Monitor internal nodes in the FPGA to expedite the debug stage of your design. ChipScope probes can be inserted from within Simulink/System Generator. They are automatically inserted into the hardware during the HDL generation stage.

System Generator Reference Designs

Ask your local Xilinx or Xilinx Distributor FAE about one of the many DSP reference designs for System Generator. These documented designs will help you accelerate your learning.

Free Online DSP Demos on Demand

See how System Generator can accelerate development of your next high-performance signal processing design by viewing one of the many DSP Demos on Demand available on Xilinx DSP Central at *www.xilinx.com/dsp*. These hour-long lectures are broken down into easily digestible, 10 minute modules.

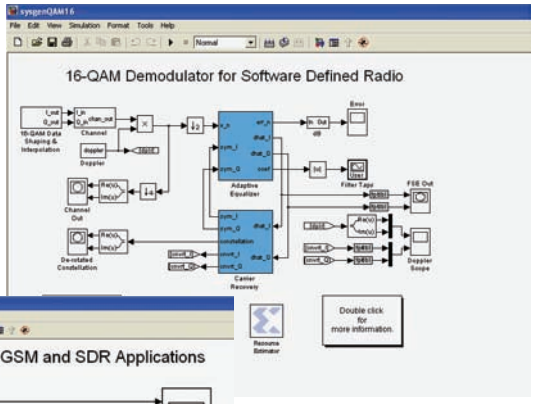


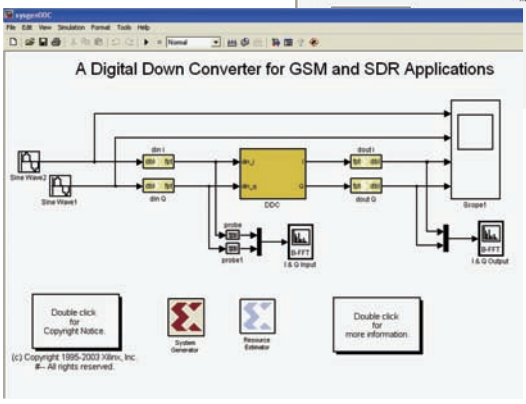
DSP Design Flow Class

You can also get on the fast track by taking the Xilinx DSP Design Flow Class. In this three-day class, you will learn how to build a design, generate hardware and debug it, all from within Simulink/System Generator for DSP. See the DSP Resources section at the back of this selection guide.

Digital Communications & Video/Imaging Reference Designs

- 16-QAM receiver, including LMS based equalizer and carrier recovery loop
- A/D and delta-sigma D/A conversion
- Concatenated FEC codec for DVB
- Custom FIR filter reference library
- Digital down converter for GSM
- 2D discrete wavelet transform (DWT) filter
- 2D filtering using a 5x5 operator
- Color space conversion
- Scaling: e.g. 4.2.2 > 4.2.0
- Image rotation
- Floating Point FFT
- Gamma Correction
- Soft Focus
- CORDIC reference design
- Polyphase MAC-based FIR
- Streaming FFT/IFFT
- BER Tester using AWGN model
- DWT
- Others





These documented designs will help you accelerate your learning.

Xilinx FPGAs—The Ideal Complement for DSPs Processors

Xilinx FPGAs are used as complementary devices for DSP processors and can complement DSP processors in many ways.

Interfacing Buses

FPGAs support many interface standards and are ideal for bus-bridging applications. Whether you are connecting serial interfaces such as Serial RapidIO and PCI Express or parallel interfaces such as PCI, PCI-X, and VLYNQ, FPGAs can handle your interfacing and bridging needs.

Interfacing Memory

No doubt you will have memory in your system so with FPGAs you can also bridge different memories using DDR, DDR2 and DDR3. In addition, Xilinx FPGAs support popular memory interfaces to DSP processors such as EMIF for TI DSPs.

Consolidating System Logic

Reducing system cost is frequently an important aspect to prolonging the life of your product in the market. By consolidating your system glue logic into the FPGA you can reduce bill of materials and form factor and save costs as a result.

Implementing New Peripherals

While DSP processor vendors go to lengths to include the right mix of peripherals on their devices, you will often need to include your own custom peripheral. An FPGA next to your processor will provide you the flexibility to include and upgrade your peripherals.

DSP Performance Acceleration

With over 350 GMACs (18 x 25 multiply, 48-bit add) of performance, Xilinx FPGAs are increasingly being used as co-processors for DSP processors in the signal chain. FPGA-based co-processing provides the performance, scalability and flexibility to tackle the most demanding DSP applications.

Xilinx Spartan-3/3E/3A and Spartan-3A DSP FPGAs are the world's lowest-cost FPGAs, ideally suited for co-processing in high-volume applications.

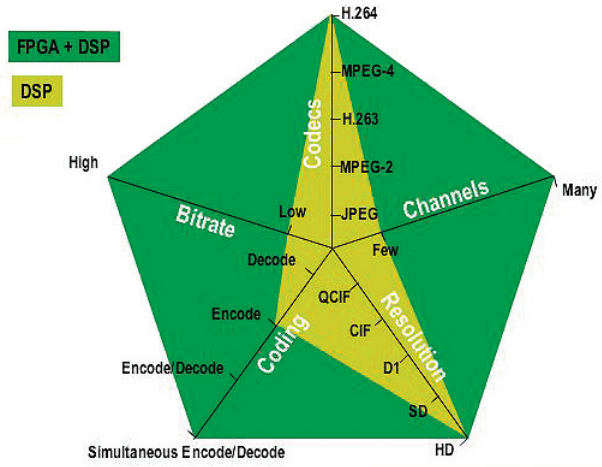
The Xilinx Virtex-5 FPGA family is the highest performance DSP family from Xilinx. With up to 640 XtremeDSP slices operating at 550MHz, these devices can implement complex tasks such as:

- High-definition (HD) H.264 and MPEG-4 encode/decode algorithms
- Many IF-to-baseband down-conversion channels
- 128X chip-rate processing for spread-spectrum systems

XtremeDSP Co-Processing

The combination of reconfigurable hardware and a programmable DSP provides a very good fit for handling highly complex signal processing algorithms. With Xilinx XtremeDSP co-processing, you can migrate computationally intensive DSP tasks to the FPGA and free up programmable DSP processors to perform other value-added software features.

Xilinx FPGAs extend the capabilities of DSP and media processors in many ways as shown.



An example is a H.264 digital video encoding/decoding system with transrating and transcoding capabilities. You can offload compute-intensive algorithms into the FPGA or extend the number of channels that can be processed or tackle higher resolutions and rates.

Fast Time to Market with Xilinx DSP Co-Processing System Design Tools

Xilinx and its partners provide complete solutions for rapid DSP co-processing development and implementation. Hardware and software development tools allow you to model your FPGA-DSP system, design the FPGA portion even if you cannot write HDL, and allow you to test and debug your design on the FPGA itself.

Software Development Tools

Xilinx provides two software tools that make it easy for DSP developers to build FPGA-based co-processors.

System Generator for DSP

System Generator for DSP is the industry's leading high-level tool for designing high-performance DSP systems using FPGAs. The tool interfaces seamlessly with The MathWorks Simulink tool. It provides abstractions that enable you to develop highly parallel systems with the industry's most advanced FPGAs, providing system modeling, automatic code generation and design verification using high bandwidth hardware co-simulation.

AccelDSP (MATLAB) Synthesis

AccelDSP Synthesis is now part of the Xilinx DSP software tool suite. The tool automates the generation of synthesizable RTL or System Generator IP blocks directly from floating-point MATLAB M-files. There is a tight integration with System Generator for mixed graphical-and language-based design flow.

Interfaces

A number of interfaces to TI™ DSPs are available as IP cores including:

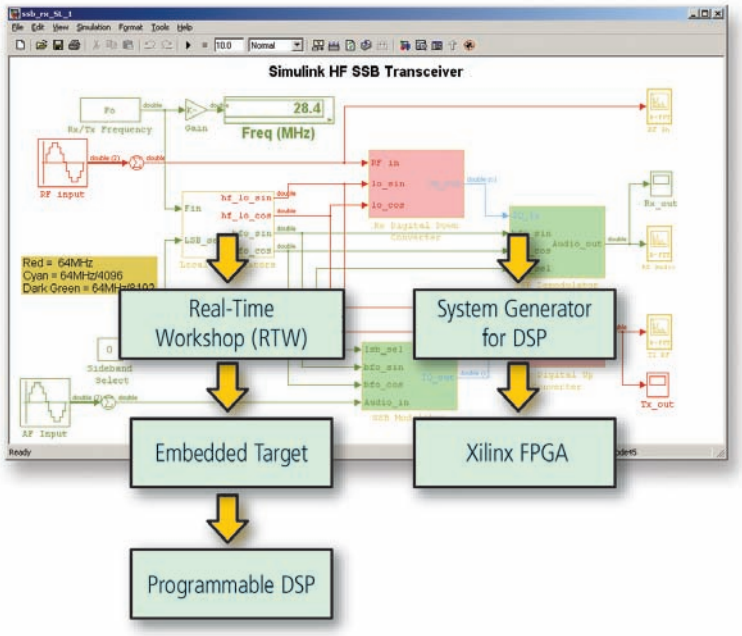
- Serial RapidIO™
- VLYNQ™
- EMIF™

Hardware Development Tools

Xilinx and third party venders offer a wide variety of co-processing hardware boards for DSP accelerator based designs.

- Avnet
- Hunt Engineering
- Innovative Integration
- Lyrtech
- Spectrum Digital
- Spectrum Signal Processing
- Sundance
- Traquair
- VITEC Multimedia
- VMETRO Transtech

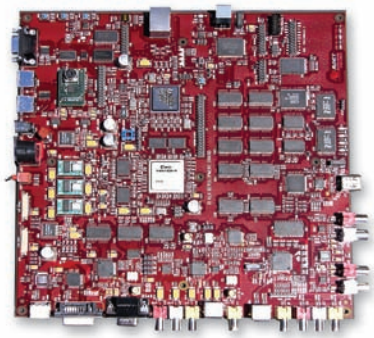
Coprocessing Designation

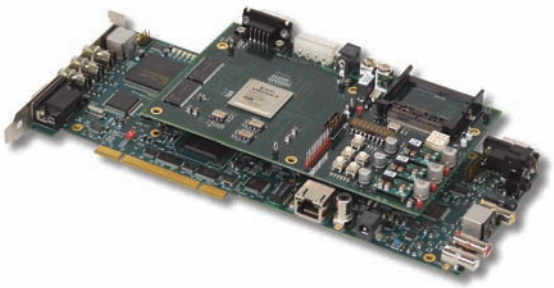


Building FPGA Co-Processors for DSPs

Building FPGA co-processors for traditional DSP processors has become much simpler using The MathWorks Simulink tool. You can first design your complete system in floating point and verify the functionality. Then by replacing floating point blocks with bit-true and cycle-true library blocks from the Xilinx blockset you can also introduce quantization to verify accuracy.

For the DSP processor portion of the design The MathWorks and Partners offer tools such as Real-Time Workshop and Embedded Target that allow you to automatically generate code.





Xilinx Education Services - the source for Xilinx education

Xilinx provides targeted, high-quality DSP education services designed by experts in programmable logic design, and delivered by Xilinx-qualified trainers. Our courses are developed to create an engaging learning environment by blending lecture, hands-on labs, interactive discussion, tips and best practices. The training is delivered when and where you need it by leveraging a global network of Authorized Training Providers and online learning systems.

Knowledge gained through Xilinx Education Services on the use of Programmable Logic Devices, design techniques, and methodologies will enable you to take full advantage of all the capabilities of today's advanced FPGAs when building your next DSP design. Equipped with this know-how, you can better innovate when developing products for your market, reduce R&D costs through a more efficient design process, and reduce production costs through the use of smaller and slower-speed-grade devices.

Xilinx DSP Curriculum Path is for developers who need to build a DSP system. The Courses within this curriculum path include lab sessions to apply the techniques and skills discussed in the class. For details on the DSP Curriculum path, and the courses that comprise it, please visit:
http://www.xilinx.com/support/training/cur_paths/atp-dsp.htm

DSP Specific Classes include:

Introduction to AccelDSP
Learn how to use AccelDSP and MATLAB to create designs optimized for Xilinx FPGAs. Highlights MATLAB coding styles that improve area and performance; and the use of floating-to-fixed-point and design exploration features of AccelDSP to achieve optimal results.

DSP Design Using System Generator
Teaches how to implement DSP functions using System Generator for DSP, design implementation tools, and hardware-in-the-loop verification.

DSP Implementation Techniques for Xilinx FPGAs
Instructs how to take advantage of the features available in the Xilinx FPGA architectures and most efficiently implement DSP algorithms. Techniques also demonstrate which decisions at the system level have the greatest impact on the implementation process and product costs.

On-Demand Webcasts

On-Demand webcasts are 60 minutes, were recorded live and now made available online. These lectures range from beginner overviews to advanced, highly technical design information. Learn more about how to design Digital Signal Processsing (DSP) applications from FPGAs.

- Introducing Virtex-5 FPGA
- Virtex-4 FPGA Design Techniques and Tools Settings for MaximumPerformance
- Virtex-5 FPGAs and PlanAhead Delvier Maximum Performance

DSP Design Services

Xilinx DSP Design Services provide you the supplementary support you may need to meet your market requirements. Our team of experts is available to help you conduct turn-key designs and ensure that you have the most optimized FPGA-DSP design for your target application. Here are some ways in which our DSP Design Services team can help you with your next design:

Create a Simulink/System Generator design – our designers will design and model all or part of your system to your specification, generate the code and verify that the design works in hardware.

Algorithm development – Some designs require the development of performance or area optimized algorithms. Use our Design Services team to develop highly optimized filters, transforms, FFTs, demodulators, error correction algorithms (e.g. Viterbi decoders) wireless designs (e.g. Rake receivers, searchers) or video codecs (e.g. MPEG 4).

Modify DSP IP cores – While our library of DSP IP cores can be parameterized, there may still cases when you need additional features that require modification to our cores. Use our Design Services team to modify these cores rather then develop them from scratch.

DSP Support / Packaged Solutions

XPA Packaged Solutions – The Xilinx Productivity Advantage (XPA) offers all of Xilinx world class Software, Education, Support Services, and IP cores in one easy to buy package. Custom tailored to your specific needs, the scalable XPA solution is the best way to get everything you or your design team need to make your next design your best.

The DSP XPA Seat is your ticket to productivity, providing you with the advanced tools and expertise you need to develop advanced, low-cost DSP designs in Xilinx industry-leading FPGAs. Save 20% when you purchase this predefined value bundle, which includes the System Generator for DSP software tools and 15 training credits.

www.xilinx.com/dsp/

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