Benefits of Integrated System Design for complex FPGAs

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Agenda

- FPGA/ASIC Trends
- Platform Based Design
- Optimizing Platform Performance
- Rapid Platform Prototyping
- Platform Design Verification
- Platform Example
- Summary
Trends - FPGA Design Starts

Number of Design Starts

120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0


102,000 107,100 94,248 84,823 80,582 74,941 68,946 62,741 56,467

* Gartner Dataquest 2004 Trends – Brian Lewis
Embedded Microprocessor Use

- Rapid Growth for Embedded Processors in FPGA’s
  - 2003: 17%
  - 2007: 37% (projected)

- Utilization of embedded processors and other embedded ASIC-macrocells in FPGAs enables:
  - High level of integration at the chip and PCB level
  - Reduced number of Components on PCB
  - Integrated System Design of the SOPCB

- But with all of this power comes complexity
  - More later…
Platform Based Design

- Traditional Platform Based Design
  - ASIC based
    - Use existing IP blocks
      - CPUs, high speed I/O’s,
      - Pre-verified cores from core vendors
  - Keys to Platform Design Success
    - Design environment/solution that provides the following:
      - Predictable / Flexible Flow
      - Design Data Management
      - IP Reuse
      - Design Data Visualization
      - Version Control
      - Powerful Design Analysis
      - Accurate Design Documentation
Design Environment for Platform Development

- HDL Import / Create
- Simulation
- Synthesis
- Flexible Design Entry
- Design Analysis
- Design Visualization
- IP / Reuse
- Documentation
- Version Control
- Flexible Flow Control
Platform Based FPGA Characteristics

- Typical Characteristics
  - Embedded Processors
    - Hard / Soft – DSP, uController, uProcessor, etc
  - Complex Architecture Specific IP
    - High Quality – Tested and Qualified
      - Vendor Provided
      - 3rd Party Provided (Mentor Inventra, etc)
  - Large Flexible Memory Blocks
  - High Speed I/Os
    - Gigabit speeds
    - Multiple signaling standard available per I/O pin
  - Multi-Million Gate Fabrics for User Logic
Why Platform FPGAs?

Discrete Component Implementation
- Low Cost PCB
- Low Cost Components

Platform FPGA:
- High Cost HDI PCB
- High Cost Components
Why?

- ASIC & System Integration + Flexibility!

Classic system designers may implement a very complex FPGA system in hours to days.
…With Power Comes Complexity

- **Challenges of Design with Platform Based FPGAs**
  - Merging of Multi-Disciplines of Individuals and Teams
    - System Level Design
    - Logic Design
    - PCB I/O Design
    - PCB Design
  - Optimizing the Platform Design
    - Performance
    - PCB Design

- **A design solution is required to**
  - Maximize productivity across the disciplines
  - Optimize the platform design
  - Provide a highly organized and repeatable process
  - Enable team based design
  - Supports leading edge FPGA platform solutions
The Solution …

- Harnessing the Power of Platform FPGAs with HDL Designer Series
Integrated System Design
Quickly Understand Designs

- Logical information extracted automatically
  - HDL code parsed rapidly
  - Syntax errors highlighted
  - “Virtual” design units are created automatically
  - Shown in Design Units view
  - Logical content analyzed down to leaf level
  - Hierarchy shown selectively in separate pane
  - Easy design navigation
Fast Custom Peripherals

Design Verification

Create Ext Signals

Create Functionality

Propagate Ext Signals Up through hierarchy quickly
Altera Nios Integration

- Supports Nios 3.1 CPU
- QuartusII 4.0 integration
  - Easy SOPC Builder plugin
- Simulation View
  (ModelSim) HDS Design Browser
- Alternative Synthesis View for LeonardoSpectrum & Precision
Platform Studio Integration

- Supports MicroBlaze 2.00.a/2.10.a & PowerPC ppc405 2.00.c via Xilinx EDK 6.1i/6.2i Platform Studio
- Xilinx 6.1i/6.2i (ISE Foundation)
  - Integrated P&R
- HDS Browser Simulation view for ModelSim
- Side Data Synthesis view for:
  LeonardoSpectrum, Precision
  Xilinx XST
  Synplify
FPGA/PCB Integration

Logical IO Definition

Add Some Physical IO Definitions (clocks, etc..)

Complete Physical IO Definitions (Inside the chip perspective only)

I/O Design done ASAP in HDS & BoardLink Pro

First Time FPGA on PCB context is defined

PCB Schematic Integration

PCB Place and Route

PCB Symbol & Package Creation

PCB Physical Analysis

Synthesis

FPGA Physical Analysis

FPGA Place and Route
FPGA/PCB Integration

- FPGA / PCB Integration Management
  - Board Station, Expedition, PADS
  - Intelligent targeting of Vendor, Device & Package
  - Drag & drop Pin & I/O Standard assignment
  - Creates and fractures Symbols
  - Creates & updates Schematic connectivity
  - Creates & maintains constraint files
- Precision, LeonardoSpectrum, Synplify, Synopsys
Designing Platform FPGAs

- Optimizing Platform Performance
- Rapid Platform Prototyping
- Platform Design Verification
- Platform Example
Rapid Platform Prototyping

- Development Boards and PCB Design
- Verification

ModelSim
Development Boards and PCB Design

- Effective use of development boards and development of the PCB in parallel can greatly increase productivity
  - Concurrent logic development
  - Concurrent SW development
    - Instantly download and test SW and/or logic in the development board
- But, poses challenges…
  - Managing the pin-out changes from the design as targeted to the development board and the PCB
    - Changing I/O changes the P&R therefore performance of the platform!
HDS + BoardLink Pro+ Precision Physical

- **HDS** - Manages the platform design and integrates with:
  - **BoardLink Pro™** to easily move between the development board and PCB design
    - Swap pins to enabled better routability and signal integrity
    - Automatically synchronize HDL design and PCB design (symbols, pin outs, etc)
  - **Physical™** to adjust to the changes in physical placement of the I/Os to maintain platform performance
HDS can manage the verification of the platform design to the:

- Development board for fast real time testing with software
- Simulator environment for stand alone IP development
Platform Example

- Let’s look at a typical example design
  - High Speed Data Processing Solution

![Diagram of Platform Example]

- External High Speed Processors
- High Speed FPGA Diff Signaling
- PPC for microcontrol of datapath
- Rocket I/O FPGA to FPGA Signaling

External High Speed Processors

High Speed FPGA Diff Signaling

PPC for microcontrol of datapath

Rocket I/O FPGA to FPGA Signaling
Integrated System Design

Applying Integrated System Design techniques to this design example merges:

- System Design
- High Speed PCB I/O Design
- High Speed PCB Physical Design
- Embedded processors (Nios, Microblaze, PPC405, ARM)
- High Data Rate Memory FPGA Interface
- High Data Rate External Processor Interface
- High Data Rate FPGA to FPGA Interface
- FPGA DSP development
- User logic development
- SW Development
Summary

- Platform FPGA Designs are Growing Quickly
- Effectively Utilizing Platform FPGA Across Disciplines for Optimal Performance On Chip and On Board Requires a Integrated System Design Methodologies/Solutions
- Harness the Power of Platform FPGAs with HDL Designer Series