FPGA Basics

Last updated 5/19/20
These slides review the basics of FPGA operation

Upon completion: You should be able to describe the operation of an FPGA device
FPGA Basics

- Field Programmable Gate Array
  - Long history
    - PROM, PAL, CPLD
    - Gate Array, Standard Cells

- Why FPGAs
  - Rapid prototyping
  - In field test / modification
  - Rapidly changing technology / standard
  - Low / mid volume production
    - High volume ➔ ASIC or ASSP
FPGA Basics

• Advantages
  • Flexibility
  • Speed to market
  • Well characterized

• Disadvantages
  • COST
  • Maximum clock frequency
  • Power
FPGA Basics

• Basic Concept
  • Many small fixed circuits
    +
  • Multiple levels of interconnect
    +
  • Programmable connections

• Enhancements
  • Fixed IP blocks
    • Memory
    • Processors
    • Interfaces
FPGA Basics

- FPGA – programmable
- 3 primary programming methods
  - RAM
    - Volatile
    - Must be loaded on power-up
    - Most common
  - Electrically erasable (flash)
    - Non-volatile
    - Expensive
  - Fuse / Anti-fuse
    - Non-volatile
FPGA Basics

- FPGA – programmable
  - JTAG Programming Configurations
    - Load programming information (xx.sof file)
    - Directly into the Configuration RAM via the JTAG interface
  - Configuration FLASH holds the default program

Src: MAX 10 FPGA Configuration Guide
FPGA Basics

- FPGA – programmable
- SRAM based

SRAM programming cell (latch)

Switches

Src: Altera - PLDBasics_FPGA_Architecture
FPGA Basics

- FPGA – programmable
- Switch configurations
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- Intel/Altera Max 10
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- Xilinx Versal
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• Xilinx Zynq
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- Intel/Altera Stratix 10
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• CRAM Configuration

http://eda.ee.ucla.edu/pub/J73.pdf