Center for Reliable Computing

Automated FPGA Fault Diagnosis

Erik Chmelar
Electrical Engineering Ph.D. Candidate
Graduating June, 2004

Acknowledgments
Shahin Toutounchi, Andrew Taylor
Xilinx, Inc.

1

FPGA Fault Diagnosis

- Field-programmable Gate Array (FPGA)
  - Configurable integrated circuit
- Fault diagnosis
  - Identify fault
    - Improve manufacturing process
- Current practice
  - *Ad hoc*
    - Manually-developed test configurations
    - Days to weeks per device
- Automated fault diagnosis
  - Use only existing test configurations
    - Hours per device

2

Automated Fault Diagnosis Process

- Determine potential faults
  - Test device
    - All or most test configurations
  - Fault locate
    - Several failing configurations
      - Identify first bistable to capture faulty value
        - » Fault in fan-in cone
- Systematically eliminate potential faults
  - Not common
    - All fault-located configurations
  - Shown not to exist
    - Passing configurations

3

Experimental Results

- 2 Xilinx Spartan-3 XC3S1000 devices
  - 90 nm process technology

Device	1	2
Failing configs*	30%	25%
Fault-located configs	5	4
First-failing bistables	1	4
Potential logic faults	34	276
Common to all fault-located configs	34	0
Not eliminated by passing configs	9	0
Potential routing faults	-	83
Common to all fault-located configs	-	27
Not eliminated by passing configs	-	9
Fault	ws_en s@1	wire s@1

*Exact number of failing test configurations intentionally not provided.

4

