"Resilient I/O System with Ability to Detect and Recovery from Line Failures"

Students: **Sam Harkness**   **Devin Mikes**   **Jeff Bahr**
  BSCpE (5/10)   BSCpE (5/10)   BSCpE (5/10)

Advisor: **Dr. Brock J. LaMeres**
  Assistant Professor

  Department of Electrical and Computer Engineering
  Montana State University
  Bozeman, MT

Acknowledgements

- Our Capstones have been sponsored through the: *ESMD Higher Education Program*

- Special thanks to our project mentor from NASA's
  *Advanced Avionics & Processor Systems (*AAPS) Project

  Dr. Andrew S. Keys
  Marshall Space Flight Center
  AAPS Project Manager

- And also to the APPS Reconfigurable Computer Task Lead

  Dr. Robert E. Ray
  Marshall Space Flight Center
  Reconfigurable Computing Task

MONTANA STATE UNIVERSITY

Overview of Project

Spring 2009 Capstone: "Resilient I/O System with Ability to Detect/Recover from Line Failures"
Sam Harkness, Devin Mikes, & Jeff Bahr

Summary: Develop an IO system that can continue to operation when a fault occurs on the physical lines of the bus (due to radiation strikes or broken conductors). The system should be able to detect faults and switch the active signals to spare lines on the bus. A GUI should be developed to monitor which lines of the IO system have been faulted.
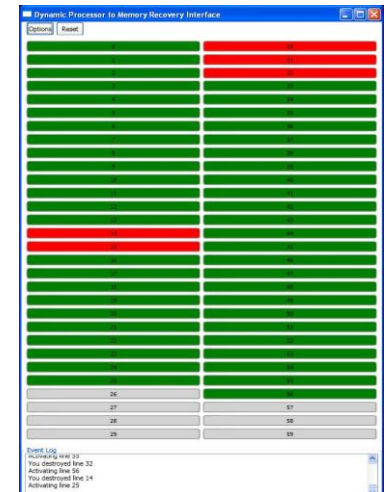
Jeff   Devin   Sam

**Prototype System
IO Bus Implemented with Wires
between two Virtex-5 FPGAs**

**GUI
(Green=active,
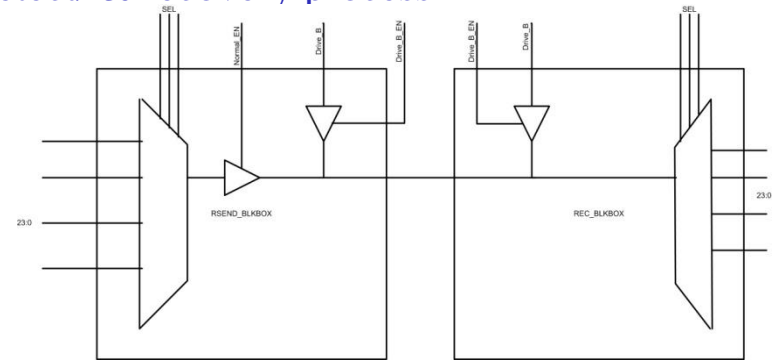Red=faulted,
gray=spare)**

Overview of Work to Date (Project #3)

Spring 2009 Capstone: "Resilient I/O System with Ability to Detect/Recover from Line Failures"
Sam Harkness, Devin Mikes, & Jeff Bahr

Theory of Operation: -

1) Spare Lines are included on the bus to be used in case of a line failure

2) A Hamming code is used to check for errors on the bus and are transmitted on the bus

3) When an error is detected, the system begins a detect/ & recovery process

- Agent A sends all 1's
- Agent B looks for all 1's, logs failures
- Agent A sends all 0's
- Agent B looks for all 0's, logs failures
- Agent B sends all 1's
- Agent A looks for all 1's, logs failures
- Agent B sends all 0's
- Agent A looks for all 0's, logs failures
- The bus lines are remapped into good lines


Total Time = (10 + n + log(n) + spare lines)

Our system = 10 + 18 + 6 + 6 = 40 clocks

where n = # of lines on bus

Overview of Work to Date (Project #3)

Spring 2009 Capstone: "Resilient I/O System with Ability to Detect/Recover from Line Failures"
Sam Harkness, Devin Mikes, & Jeff Bahr

Highlights: - successfully demonstrated to Robert Ray & Leigh Smith at Fall-09 Design Fair
- currently filing an invention disclosure with MSU (first time for the students)
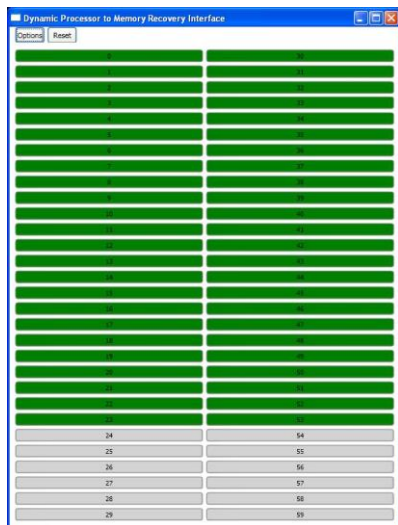
**IO bus in Tact, GUI
indicates all lines good**
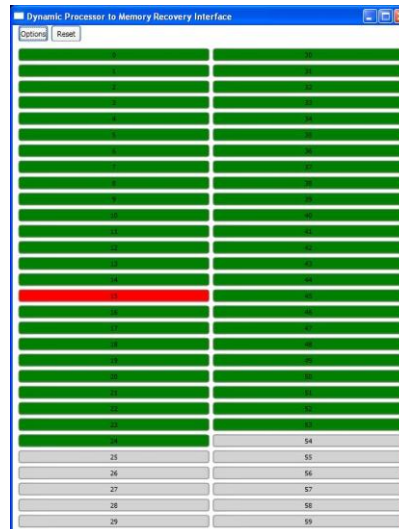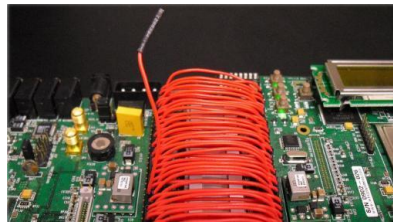
**Wire pull on line 15, GUI indicates fault
and that a spare has been brought online**

**System Demonstration at
MSU Fall-2009 Design Fair**
(Sam Harkness giving Leigh Smith Demo)

Questions?