

Internet-based Tool for System-On-Chip Project Testing and Grading

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<http://www.cs.wustl.edu/~lockwood/class/cs536/index.html>



Testing and Grading Server

- Performs testing in FPGA hardware
- Runs remotely over the Internet
- Generates report with test results
- Grades design as “pass” or “fail.”
- Allows class to share single FPGA platform
- Keeps hardware available to students 24/7






Designing A Reconfigurable System On-Chip Firewall

- Two Part Graduate Course
 - Machine problems to implement an Internet firewall
 - Group projects to extend firewall's features
- Offered Fall '02
- 30 Students



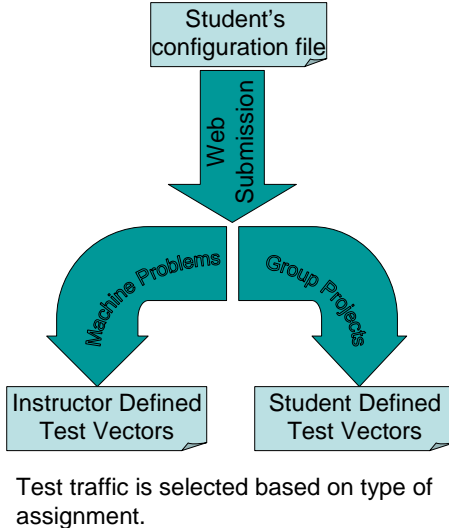
1-2-3 Step Design Verification

-  1 User Uploads Test Parameters
-  2 Server Runs Automated Tests
-  3 User receives Immediate Pass/Fail



1 Student Uploads Test Parameters

- Student uploads place and routed bitfile
- Student uses 5-digit ID for anonymity
- Server validates file for hardware compliance

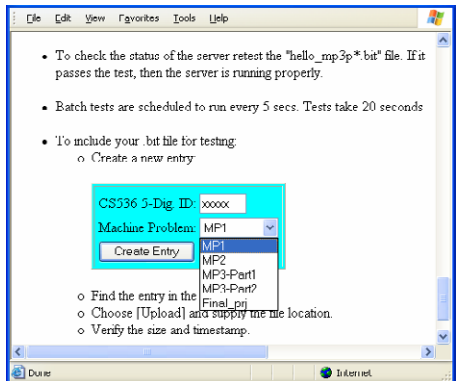


Test traffic is selected based on type of assignment.

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1 Machine Problem Testing

- Student selects assignment
- Different test vectors for each machine problem
- Test vectors passed through design as Internet packets.



Web Upload Script for Configuration Files

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Group Project Testing

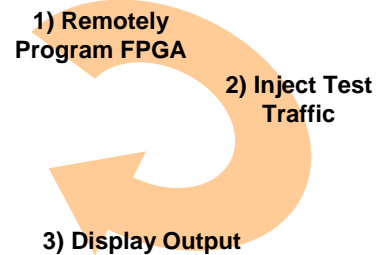
- Student uploads text file with custom test traffic
- File format is identical to the functional VHDL testbench test traffic format
- Easy to migrate to hardware testing

xxxxx_mp1.bit	[Upload] , [Test_Again]	0	Wed Apr 9 22:02:04 2003	UPLOAD FILE	UPLOAD FILE
NAT02_final.bit	[Upload] , [Test_Again]	1270034	Sun Dec 8 14:59:27 2002	TEST PENDING	[Upload INPUT CELLS]. NAT02_input_cells.txt
napad_final.bit	[Upload] , [Test_Again]	1270032	Wed Dec 11 10:23:20 2002	napad_final_results.html	[Upload INPUT CELLS]. napad_input_cells.txt



Server Runs Automated Tests

- Programs FPGA
- Passes Internet traffic through firewall
- Records output traffic
- Tests next design in queue



Server's Circular Functionality



Student Receives Immediate Pass/Fail

- Output traffic is compared to results of a working solution
- Server returns “pass” if results are identical

File	DocBot Operation	Size	Last Modify	Results	Result Posted
hello_mp3p2.bit	[Test_Again]	1270034	Sun Nov 24 16:20:37 2002	hello_mp3p2_results.html	PASSED
12345_mp3p2.bit	[Upload], [Test_Again]	1270034	Tue Dec 10 22:51:57 2002	12345_mp3p2_results.html	NOT PASSED Fri Dec 13 15:26:43 2002
xxxxx_mp1.bit	[Upload], [Test_Again]	0	Wed Apr 9 22:02:04 2003	UPLOAD FILE	UPLOAD FILE

Pass / Not Pass Test Status



Easy to Read Results

- Results show both input and output packets
- Packets are displayed as HTML tables with labels and color coded header fields
- Fields important for debugging are highlighted in orange

```

INCOMING PACKET 3:
 31.24 23.16 15.8 7.0
0x00000000
FF26, 8726, 145, 2720
0x81 0x00000000
ABC=0x01 PAD
0x81 0x00 0x0000
Var=4,HL=5 T0S=0x00 Packet_Len=99 Bytes
0x0000 0x0000
IP_ID=0x0000 Fragment=0x0000
0x3E 0x06 0x0be7
TTL=63 Proto=6 Checksum=0x0be7

0x74000001
Src_IP=127.0.0.1
0xc0829401
Dest_IP=204.171.145.1
0x0007 0x0000
PloadID=0000 Test_Port=19
0x0003101e
Seq_Number=40448110
0x340ccf1c
Ack_Number=142770000
0x5018 0x1000
HL=5, RevFlag=0x018 Window_Size=4096
0x3E12 0x0000
Checksum=0x3E12 Fragment=0x0000
0x575628e 0 0 0 0 0 0 0
Data 0
0x555745A 0 0 0 0 0 0 0
Data 1
0x043555 0 0 0 0

```



```

OUTGOING PACKET 1:
 31.24 23.16 15.8 7.0
0x000009a0
VP=0, VCI=154, PT=0
0x81 0x00000000
ABC=0x01 PAD
0x81 0x00 0x0000
Var=4,HL=5 T0S=0x00 Packet_Len=99 Bytes
0x0000 0x0000
IP_ID=0x0000 Fragment=0x0000
0x3E 0x06 0x0be7
TTL=63 Proto=6 Checksum=0x0be7

0x74000001
Src_IP=127.0.0.1
0xc0829401
Dest_IP=204.171.145.1
0x0007 0x0000
PloadID=0000 Test_Port=19
0x0003101e
Seq_Number=40448110
0x340ccf1c
Ack_Number=142770000
0x5018 0x1000
HL=5, RevFlag=0x018 Window_Size=4096
0x3E12 0x0000
Checksum=0x3E12 Fragment=0x0000
0x575628e 0 0 0 0 0 0 0
Data 0
0x555745A 0 0 0 0 0 0 0
Data 1
0x043555 0 0 0 0

```





Book-Keeping

- Records time stamp at completion of assignment
- Prevents same bitfile being submitted by multiple students
 - E-mails alert when infraction occurs
- Maintains Grade Log

Index of /cs536/logs

Name	Last modified
Parent Directory	15-Jan-2003 16:42
audit.txt	04-Nov-2002 11:32
cheat/	02-Nov-2002 17:12
mp3p1_pass_log.txt	23-Nov-2002 10:20
mp3p2_pass_log.txt	03-Jan-2003 13:22
pass_log.txt	13-Dec-2002 00:05
pass_log_mp1_plus.txt	27-Sep-2002 15:29

```

Mon Nov 4 11:31:19 CST 2002
*****
FOUND IDENTICAL BIT FILES:
17317_mp3p1 AND ethan_mp3p1
*****
  
```

```

44055_mp3p1 successfully tested
Mon Oct 14 04:05:23 CDT 2002
-----
33283_mp3p1 successfully tested
Mon Oct 14 04:05:45 CDT 2002
-----
  
```



Server Hardware Platform

- Developed Using Field-Programmable Port Extender (FPX)
 - Re-configurable over network
 - Hardware-based IP stack
 - SRAM and SDRAM
 - Gbit/s links
 - Open Source Control Software (NCHARGE)
- Acknowledgments
 - Todd Sproull for his work on NCHARGE



<http://www.arl.wustl.edu/arl/projects/fpx/>

