

NetFPGA: An Open Platform for Building Extensible Networks with Reconfigurable Hardware

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<http://NetFPGA.org>



NetFPGA Enables

- **Emulation of Networking systems**
 - Results obtained at Gigabit Speeds
- **Experiments with multiple systems**
 - Measurements performed with live traffic

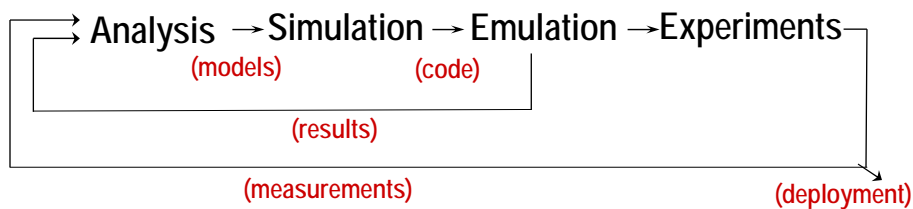


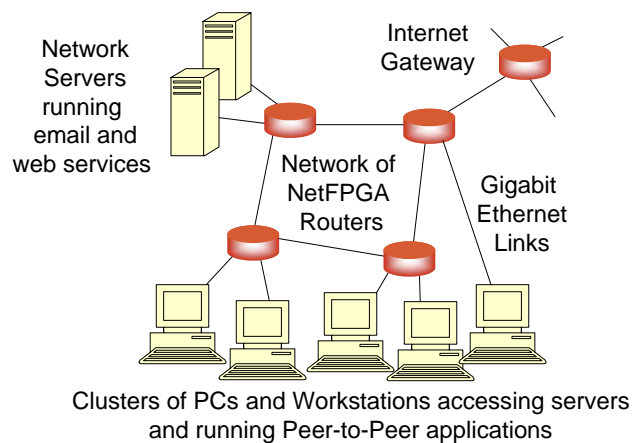
Diagram by: Larry Peterson (Princeton University)

Motivation to Teach Network Hardware

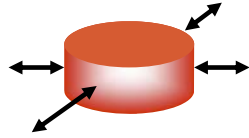
- **Research and Education**
 - Students Today
 - Build network systems mostly with software
 - Students Tomorrow
 - Can quickly learn to also build system components in hardware
- **Interesting Topics for Networking Hardware**
 - Switching and Routing
 - Gigabit-rate networking
 - Network Security
 - Intrusion Detection and Prevention Systems (IDS, IPS)
 - New Protocols
 - Wire-speed Content Routing and Clean-slate designs



Intrenet Routing & Switching



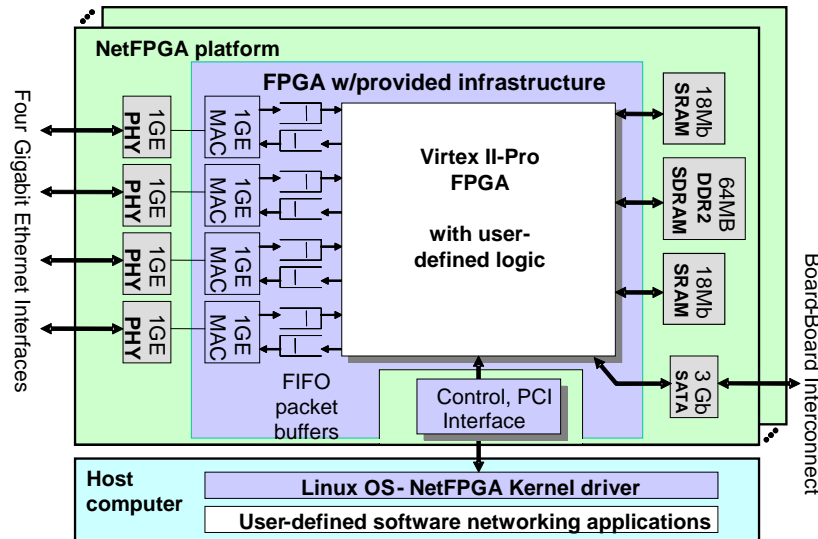
NetFPGA Platform



- **Function :**
 - 4 Gigabit Ethernet ports
- **Fully programmable**
 - FPGA hardware
- **Low cost**
 - Widely deployable platform
- **Open-source FPGA hardware**
 - Routing hardware base in Verilog
- **Embedded Software**
 - Host PC, Embedded PowerPC, and/or software LEON or Microblaze
 - Drivers in C and C++



NetFPGA Block Diagram



Details of the NetFPGA (ver 2.1)



- Fits into Standard PCI Host Interface
- Provides 4 Gigabit Ethernet Interfaces
- Enables hardware-accelerated processing of content using Field Programmable Gate Array (FPGA) logic & attached memory
 - Virtex-2 Pro FPGA
 - 4MB ZBT SRAM
 - 64MB DDR2 DRAM



NetFPGA Reference Routing System

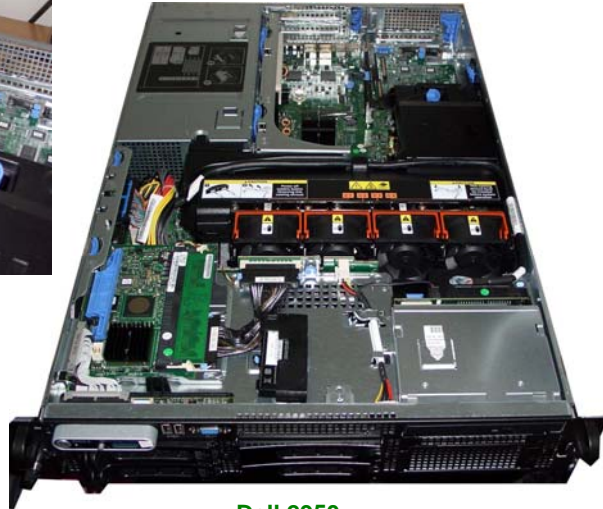
- **NetFPGA**
 - Quad Gigabit Ethernet Ports
- **Gigabit Host Ports**
 - Dual Gigabit Ethernets
- **Processor**
 - Dual-Core Athlon-64
- **Operating System**
 - Linux CentOS 4.4
(or Fedore Core, RedHat ..)



Internet2 Machines - Tested fine with the NetFPGA



NetFPGA properly recognized in PCI-X slot



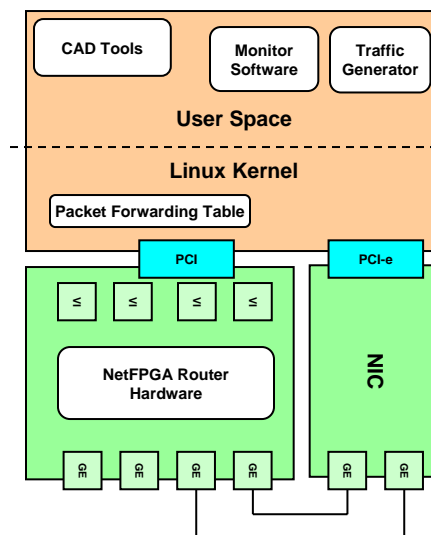
Dell 2950 with PCI-X and PCI-Express Slots

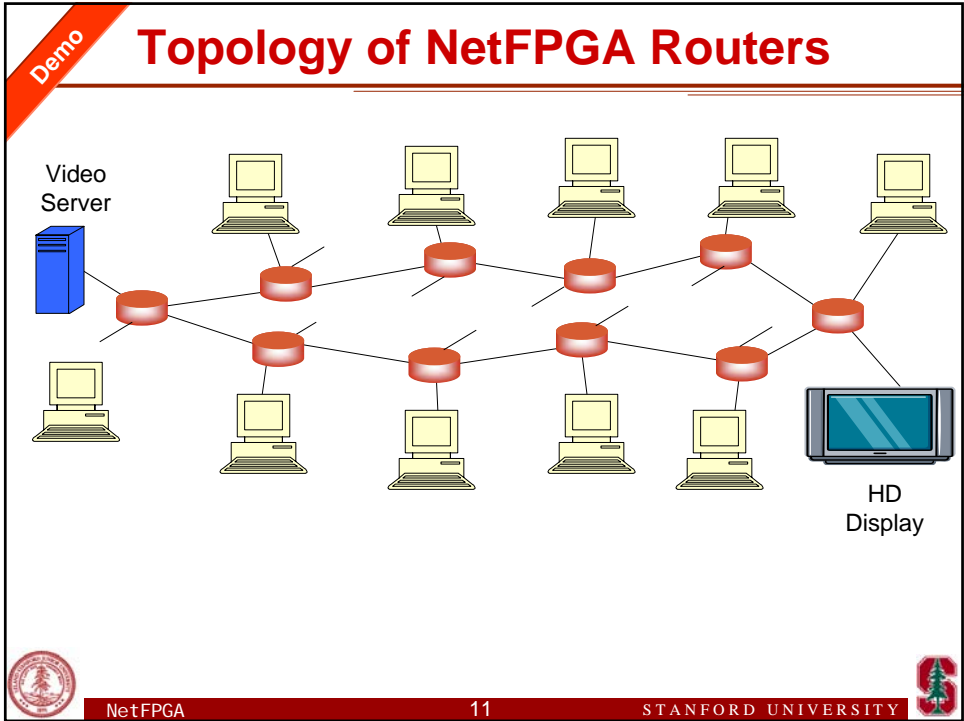


Thanks: Brian Cashman for providing machine



Hardware and Software View





Demo **Streaming Video through the NetFPGA**

- **Video server**
 - NetFPGA Router
 - Apache Web server
- **Video client**
 - Windows Media Player
 - Linux mplayer
- **Video traffic**
 - MPEG2 HDTV (35 Mbps)
 - MPEG2 TV (9 Mbps)
 - DVI (3 Mbps)
 - WMF (1.7 Mbps)

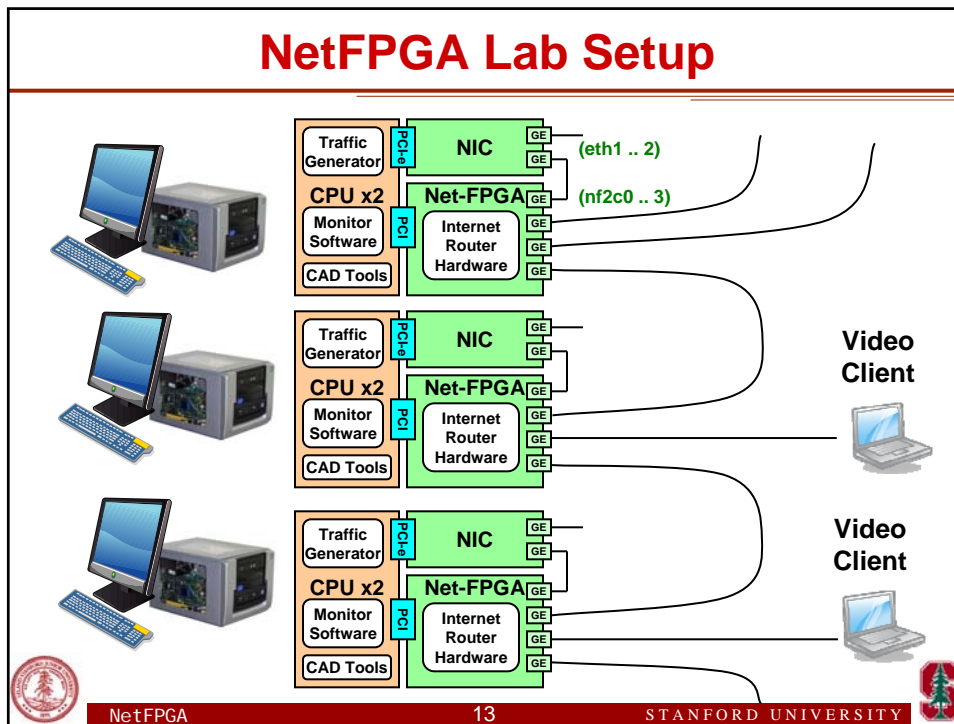
Index of /video

File	Last modified	Size
index.html	02-Sep-2006 09:59	528K
index.mpeg	19-May-2007 05:31	1.2G
index.wmf	19-May-2007 05:22	118
index.wmf	19-May-2007 03:46	793K
index.wmf	21-Dec-2003 14:38	112K
index.wmf	18-May-2007 04:34	141K
index.wmf	04-Feb-2004 18:14	3.4K
index.wmf	18-May-2007 03:59	-

Apache/2.0.32 (CentOS) Server at sf-netfpga.stanford.edu Port 80

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NetFPGA Lab Setup



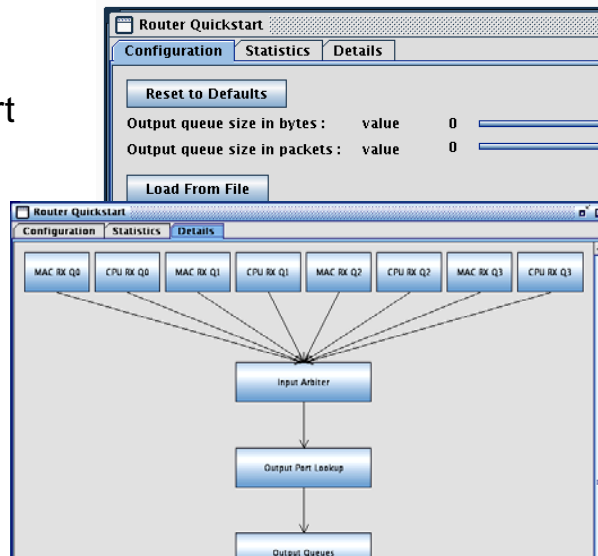
Explore Router Architecture with GUI

GUI Configuration

- Router Quickstart configuration

Reference details

- simple
- modular
- pipeline



Networking Hardware Education

- **CS344 Course @ Stanford**
 - Build an Internet router in 8 weeks
 - Hardware forwards packets
 - Software implements pw-OSPF
- **CSE565, CSE566 Courses @ WU**
 - Accelerate Networking algorithms in hardware
 - TCP/IP Flow processing
 - Build a Reconfigurable Networking System-on-Chip
 - Intrusion Detection and Prevention Systems
- **Tutorials and Workshops**
 - SIGMETRICS : June 12, 2007 in San Diego, CA
 - Hot Interconnects : August 24, 2007 at Stanford, CA



cs344: Build an Internet Router in 8 weeks

- **Stanford class offered Spring '03, '05, '07**
 - Laboratory utilizes NetFPGA hardware
- **Organized as student teams working on projects**
 - One hardware developer + one-two software developers
- **Results**
 - Students start with baseline
 - Two port learning Ethernet switch
 - pw-OSPF software
 - Students build
 - Four-port Gigabit-speed Internet Router
 - Hardware performs MAC address learning & IP forwarding
 - Software performs OSPF distributed routing



Project Homepage: <http://NetFPGA.org>

NetFPGA Overview

The NetFPGA platform enables researchers and instructors to build working prototypes of high-speed, hardware-accelerated networking systems. The platform can be used in the classroom to teach students how to build Ethernet switches and Internet Protocol (IP) routers using hardware rather than software. The platform can be used by researchers to prototype advanced services for next-generation networks.

Open Platform

The NetFPGA is an open platform and available to developers worldwide. Reference designs included with the system include an IPv4 router, an Ethernet switch, and a four-port NIC. Researchers have used the platform to build advanced network flow processing systems. Multiple platforms could be connected together to route packets over multiple subnets.

The system consists of a reprogrammable development board, reference implementations, and sample coursework. The development board itself is a PCI card that can be installed in any PC with an available full-length slot. Hosted on the board are a user-programmable FPGA (with two PowerPC processors), SRAM, DRAM, and four 1 Gbps Ethernet ports.

Programming and administration of the development board are performed by the host PC via the PCI bus. This allows users to remotely develop and deploy designs since physical access to the board is not required.

NetFPGA platform architecture:

- Host computer
- Linux OS - NetFPGA Kernel driver
- User-defined software networking applications
- NetFPGA platform
- FPGA w/provided infrastructure
- User-defined logic
- Xilinx Virtex 5K100 FPGA
- FPGA packet buffers
- Control, PCI interface

Request Hardware: <http://NetFPGA.org>

NetFPGA Interest Survey

If you are interested in obtaining *NetFPGA* hardware, please answer the following questions. Questions marked with a * are mandatory, while those not marked are helpful. The more information you provide, the better we can help you.

Information collected on this form is being used to estimate the interest number of units that should be manufactured. Production and testing of the *NetFPGA* hardware is underway. The *NetFPGA* boards should be available for 3rd party developers from our manufacturing partner, in the late summer of 2007.

If you are interested in using *NetFPGA* hardware, we highly recommend that you consider registering for the *SIGMETRICS* or *HotI* tutorials scheduled for or *HotI* tutorials scheduled for June 12, 2007 in San Diego, CA and August 24, 2007, at Stanford University, respectively.

Information about yourself

- *Name:
- *Title:
- *Institution:
- *Email:
- *Phone:
- Personal Webpage:
- Group Webpage:
- *Address:
- *City:
- *State:
- *Country:

Upcoming NetFPGA Tutorials

- **SIGMetrics :**
 - Half-day Tutorial
 - June 12, 2007
 - San Diego, California

http://www.cs.cmu.edu/~sigm07/workshops.html#TUTORIAL_2
- **Hot Interconnects :**
 - Full-day Tutorial
 - August 24, 2007
 - Stanford, California

<http://www.hoti.org>
- **NetFPGA Homepage**

<http://NetFPGA.org>

