

Review of:
GRIP: A Reconfigurable Architecture for Host-Based Gigabit-Rate Packet Processing

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Introduction

- Motivation for the work
 - Problem:
 - just transmitting and receiving data at gigabit speeds bogs down a standard workstation
 - especially a burden to bus performance
 - add processing of the packets to this and the workstation won't have much time for anything else
 - Solution:
 - GRIP (Gigabit Rate IPsec): a NPU (Network Processing Unit)?
 - offload as much of the network processing to an FPGA as possible (as many network layers as possible on an application basis)
 - example: an encrypted connection might offload all the encryption and decryption to the GRIP processor

Network Layers

OSI Layers		
	7	Application
	6	Presentation
	5	Session
	4	Transport
Routers	3	Network <small>IPsec</small>
Bridges	2	Data Link <small>LLC MAC</small>
WDM	1	Physical <small>Transceiver Fiber Optics Cables</small>

Figure 1. OSI 7-Layer Model

Example Applications for GRIP

- **Intrusion Detection**
 - offload up to the link layer
- **IPSec**
 - offload up to the network layer
- **Protocol Processing**
 - offload up to the transport layer
- **Parallel Computing**
 - offload up to the application layer

SLAAC-1V Architecture

- uses SLAAC-1V card as base
 - reconfigurable platform
 - 3 Xilinx Virtex 1000 FPGAs (X0, X1, X2)
 - connected by a 72-bit ring bus plus a 72-bit shared bus
 - X0 has PCI interface circuitry which takes up 20% of chip
 - 2 configurable clocks for each FPGA
 - 10 ZBT SRAMs
 - 11 MB total SRAM
 - 3 GB/s memory bandwidth
 - bitstream cache capable of holding 7 Virtex 1000 bitstreams
 - can perform partial configuration of FPGAs

SLAAC-1V Architecture

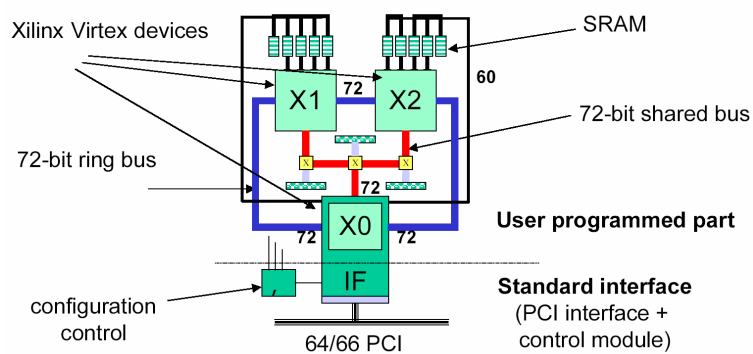


Figure 2. General SLAAC-1V architecture

GRIP Architecture (modified SLAAC-1V)

- GRIP adds two features to the SLAAC-1V
 - a gigabit Ethernet card daughter card was added
 - provides...
 - an integrated physical layer
 - interface for the media access controller to the FPGAs
 - some packet buffering and filtering
 - an augmented PCI interface
 - adds...
 - high-performance DMA capabilities
 - support for 64/33 or 64/66 PCI
 - packet switching and framing
 - » make larger frames for better efficiency

GRIP Architecture (modified SLAAC-1V)

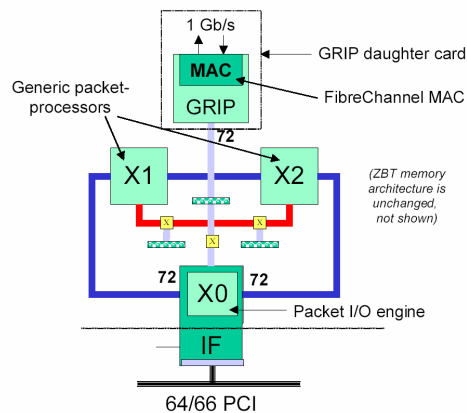


Figure 3. Block diagram of the SLAAC-1V architecture modified for GRIP

The Daughter Card

- MAC controller has more connector pins than the SLAAC-1V can accommodate
 - use another FPGA on the daughter card (Virtex 300) to simplify the interface
 - uses two 512K x 16-bit ZBT SRAMs for buffering

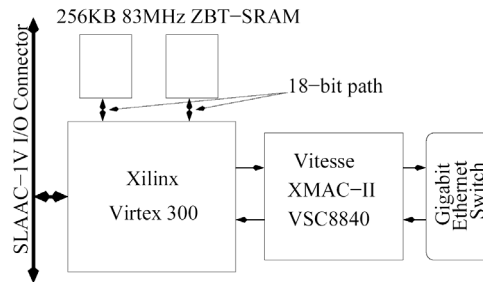


Figure 5. Block diagram of the GRIP daughter card

Layout of GRIP Processing

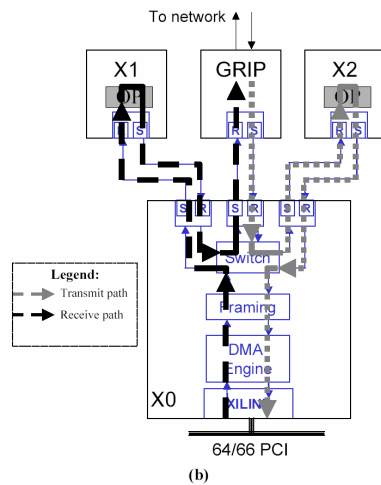


Figure 6. (a) Block diagram of the X0 design. (b) Sample packet flow through X0.

Testing the GRIP cards

- basic functionality
 - connected hosts with GRIP cards to the Internet
 - verified that they were capable of performing normal network functions
- functionality with packet processing
 - used 128-bit AES encryption and decryption modules to test functionality
 - communicated between two GRIP cards
- bandwidth testing

Testing the DMA Performance

- 512 DMA transfers of 2MB each
 - 96% efficiency for 32/33 MHz
 - 52% efficiency for 64/66 MHz

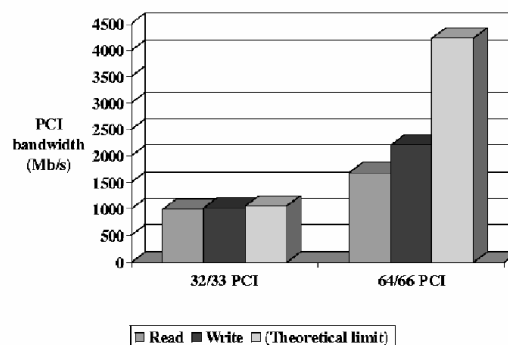


Figure 8. SLAAC-1V DMA throughput

Testing the Infrastructure Bandwidth

- frame size
 - 8900 bytes
 - 610 Mb/s
 - 4500 bytes
 - 450 Mb/s
 - 1500 bytes
 - 300 Mb/s

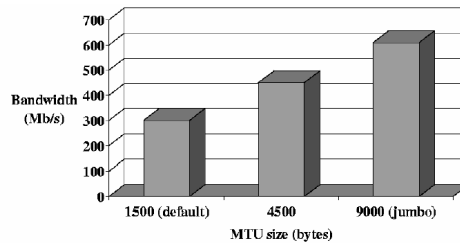


Figure 9. GRIP network throughput

Bandwidth Limitations

- Problems:
 - clock rate of daughter card limits max throughput
 - error-prone independent clock domains
 - GRIP driver has not been optimized
- Hopes:
 - to eliminate these problems and achieve 1Gbps

Next Generation: GRIP2

- additional logic resources
- additional RAM
- additional RAM bandwidth
 - current = 2 Gbps
 - desired = 4 Gbps
- low cost
 - eliminate the need for the SLAAC-1V
 - use cheaper Osiris setup

Next Generation: GRIP2

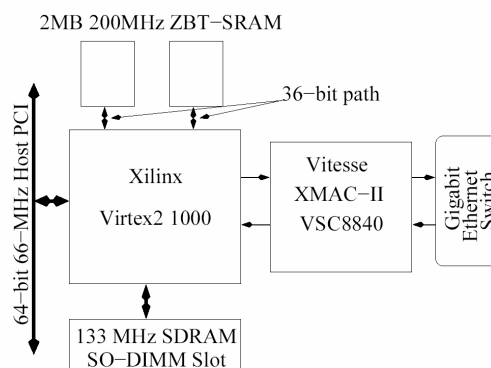


Figure 10. A block diagram of the second-generation GRIP card

Osiris Card for GRIP2

- Xilinx Virtex-II 6000
- ten 250 MHz ZBT-SRAMs

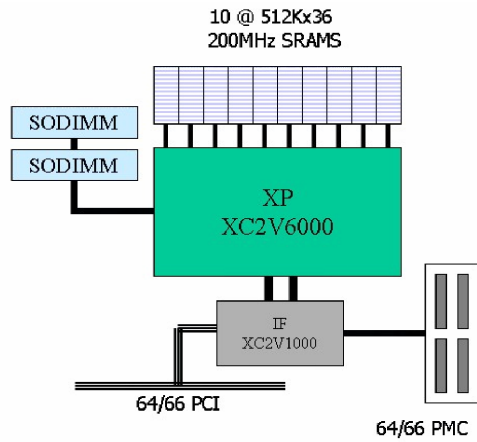


Figure 11. A block diagram of the Osiris card

Conclusion

- a good first look at GRIP and what it's about
- seems like a host-based version of an FPX