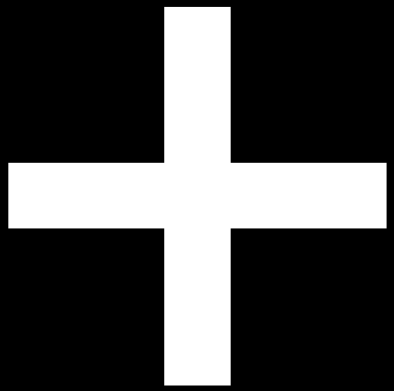
FreeBSD support for Stanford NetFPGA

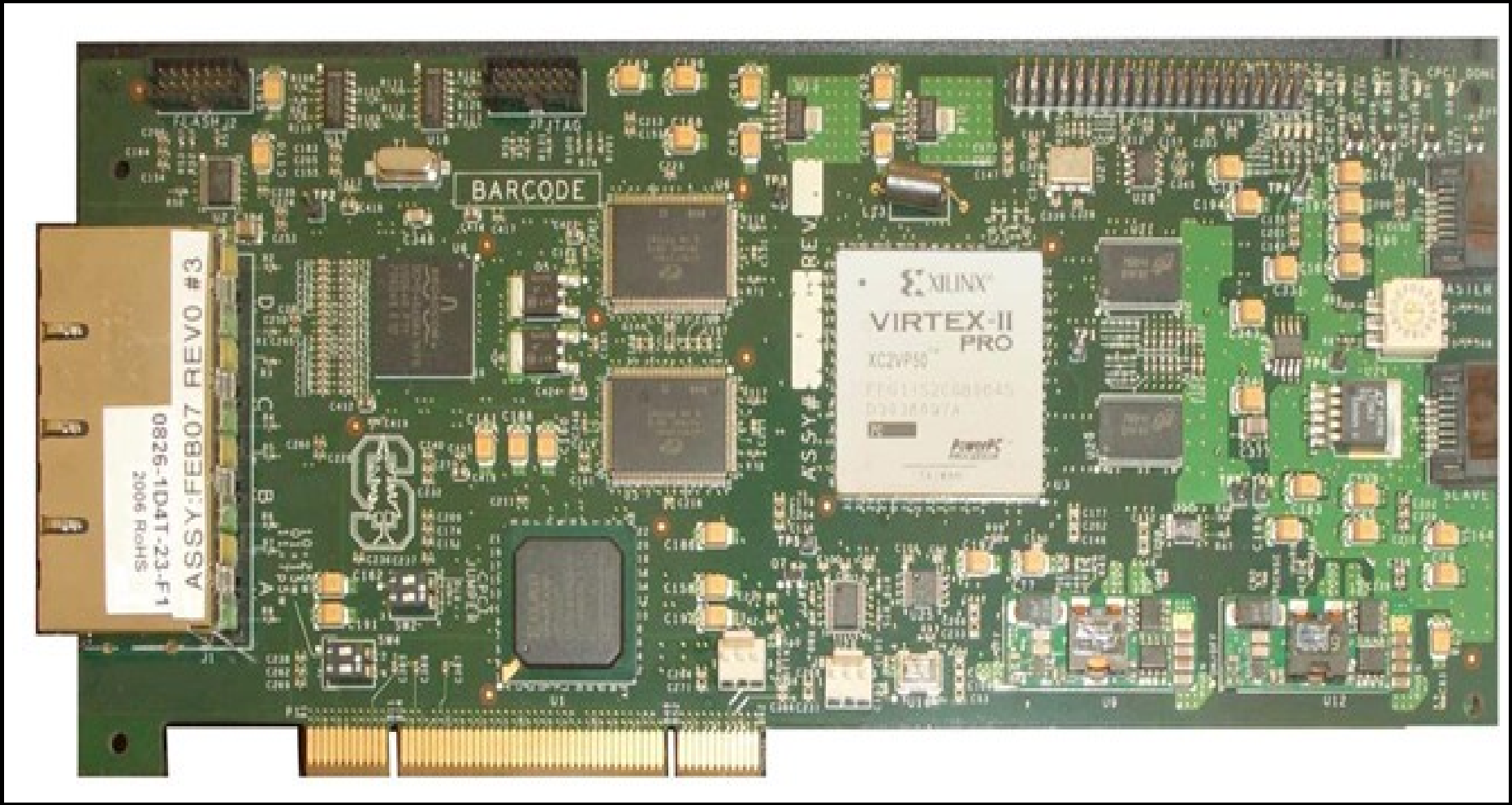
Wojciech A. Koszek
wkoszek@FreeBSD.org
2009.08.25

This summer was quite cool...

FreeBSD system..

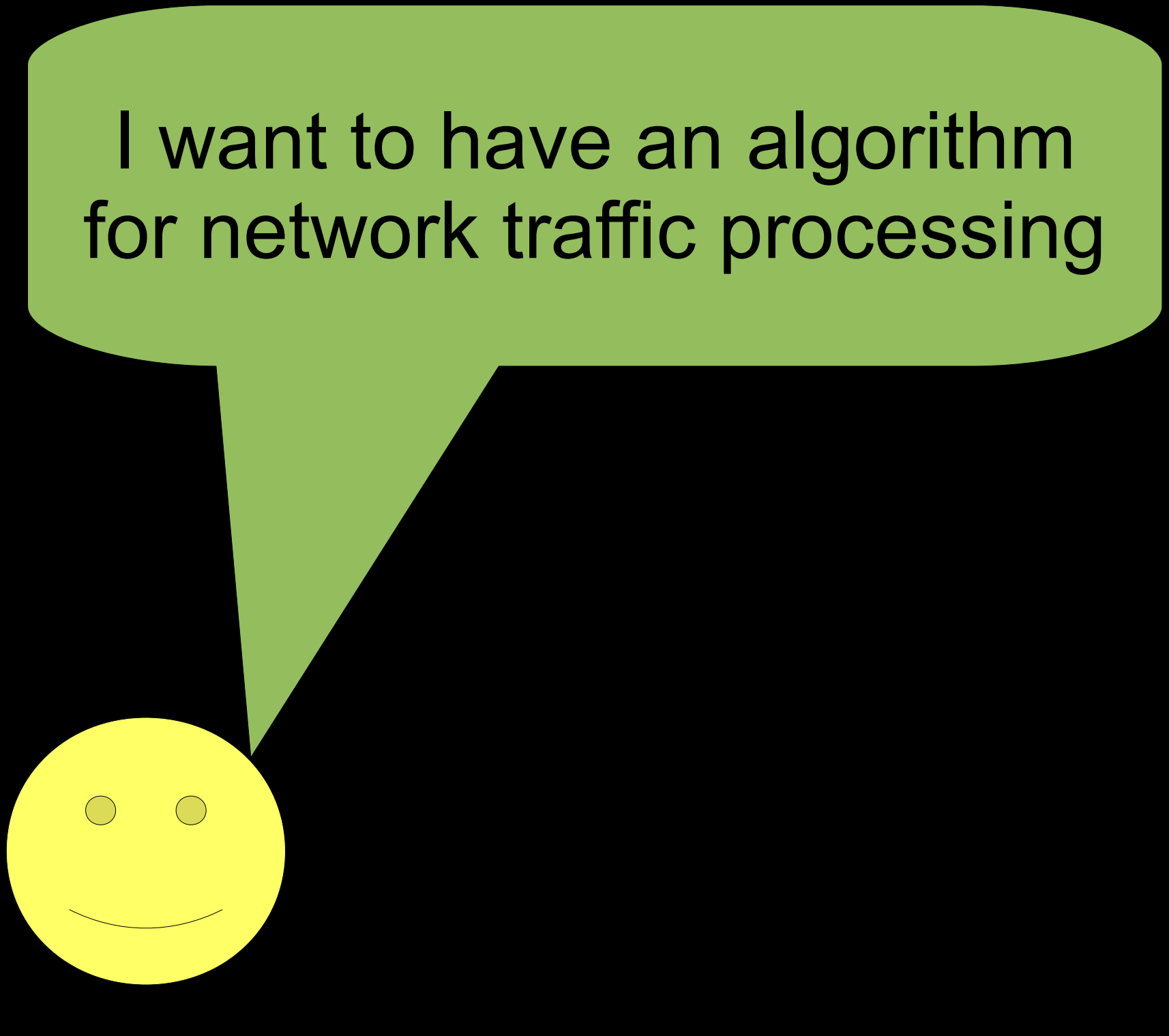


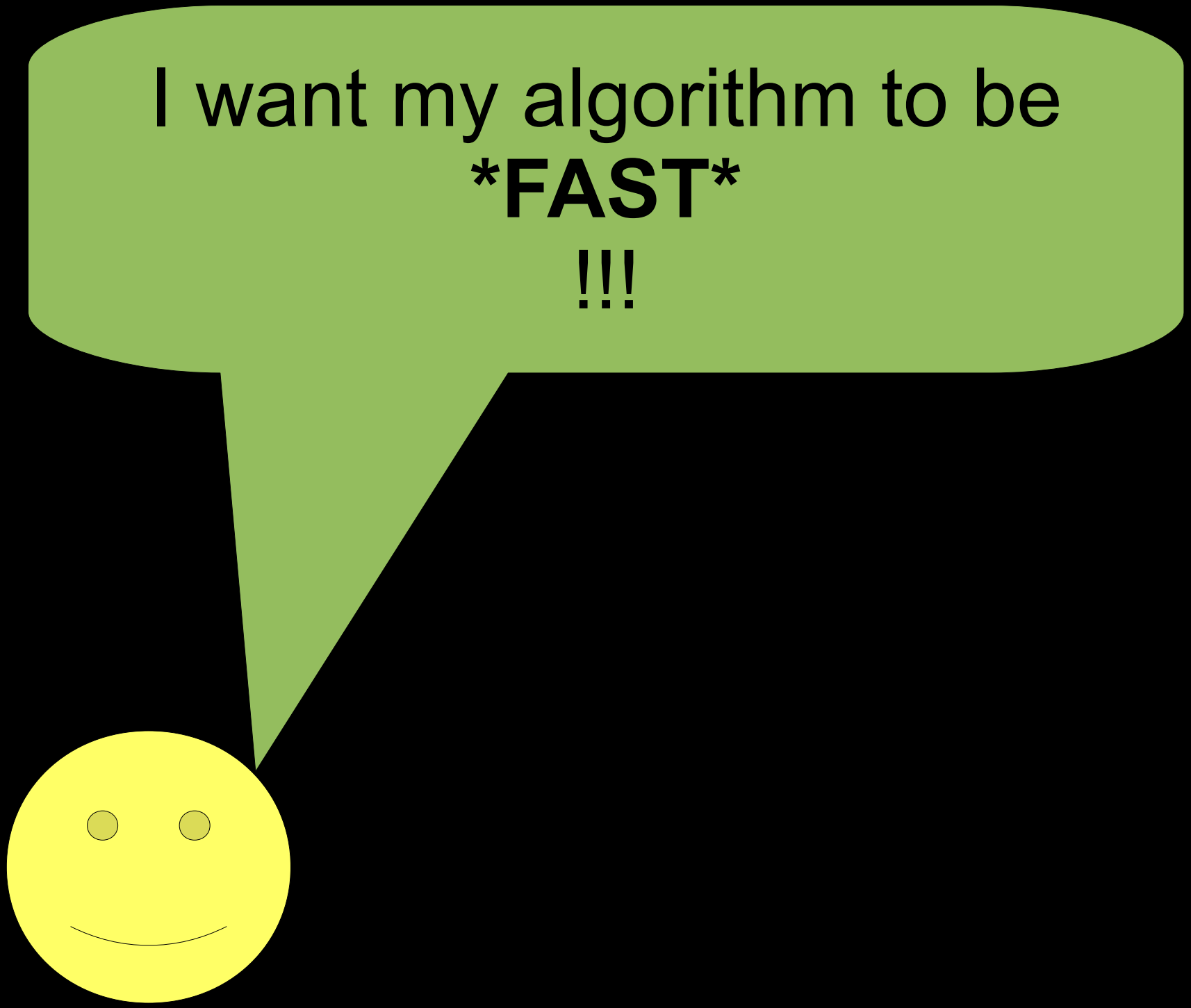
NetFPGA card

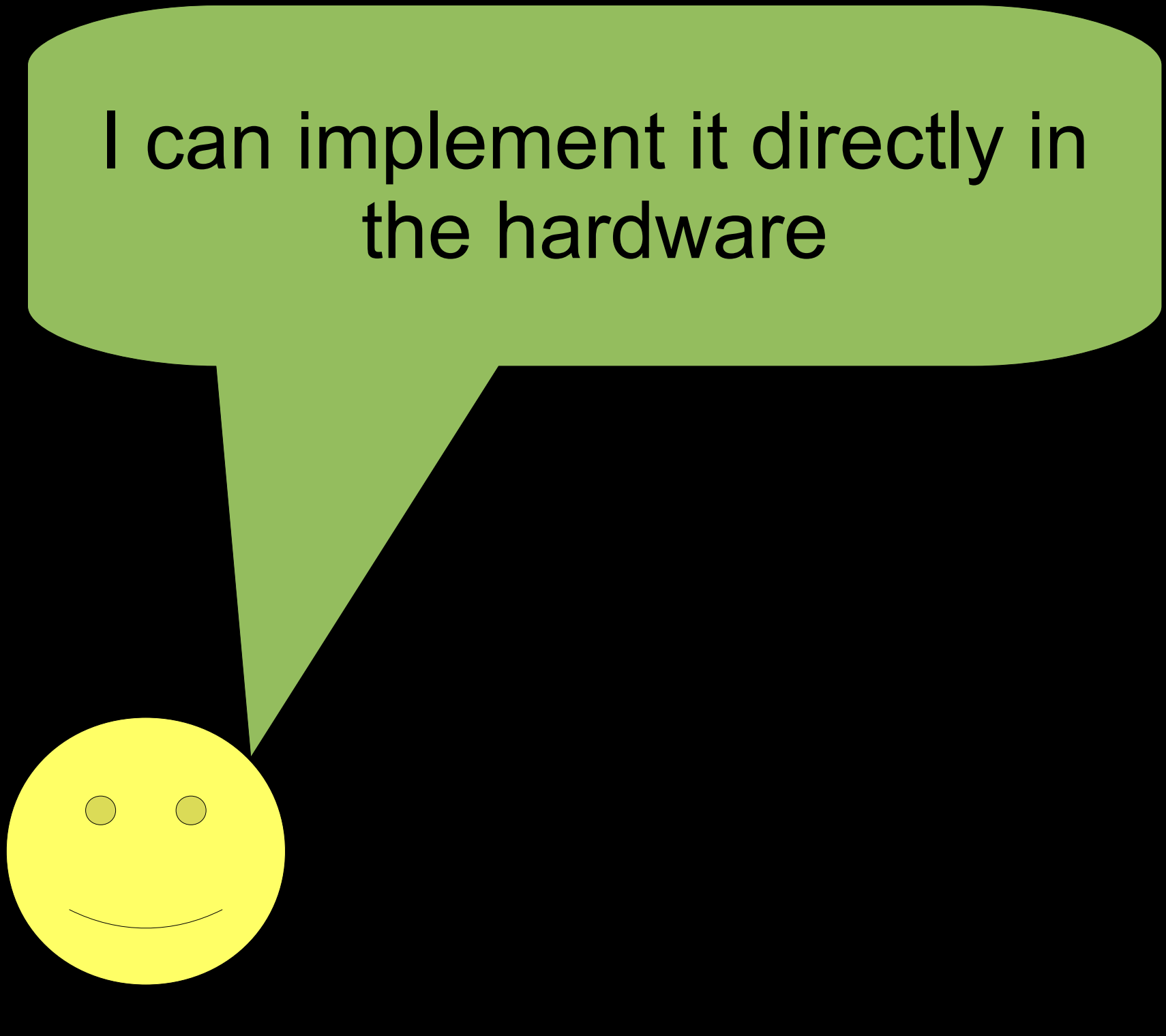


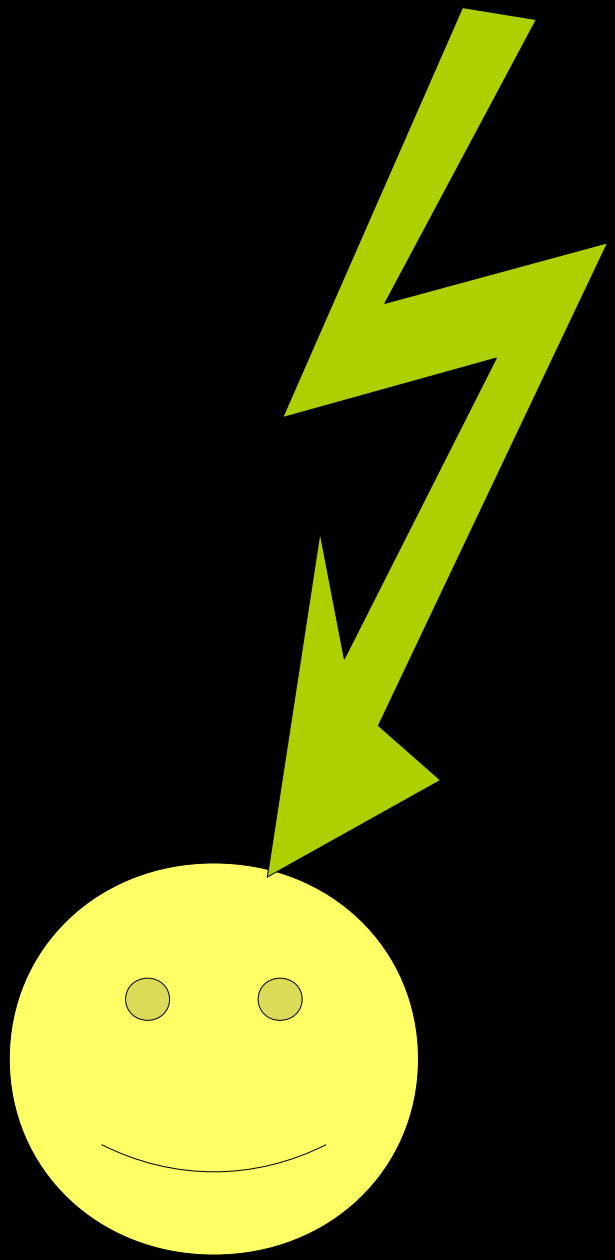
Why is NetFPGA cool?

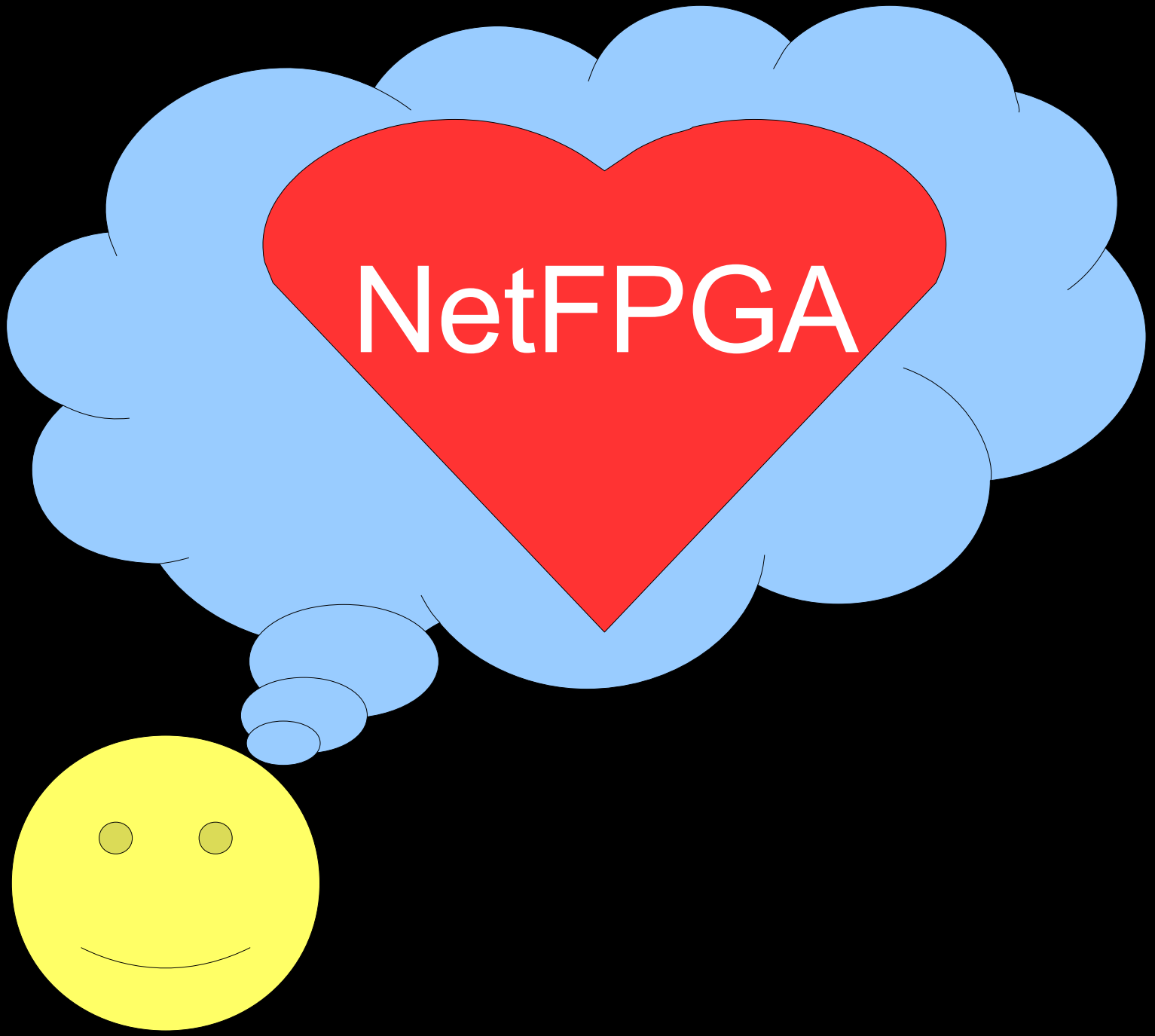
One of the first network adapters that let you to control everything by yourself!


I want to have an algorithm
for network traffic processing


I want my algorithm to be
FAST
!!!


I can implement it directly in the hardware




NetFPGA

You want your algorithm to run on a stable base...

You consider your work important and you'd like to deliver it with the best possible quality...

You want to use academic/ research/industry standards

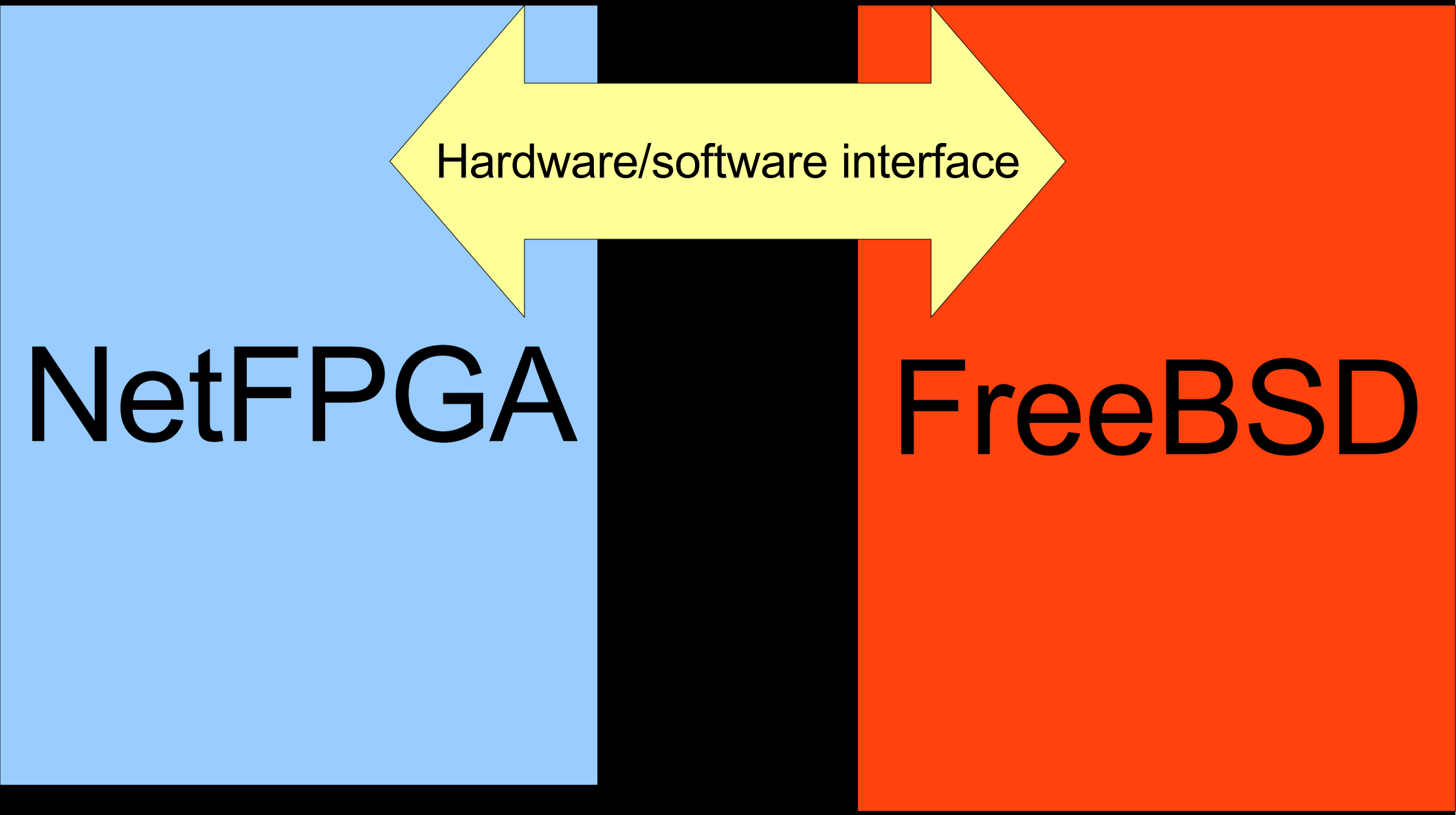
But you also plan to use your work so that it can be incorporated in ***your*** product

…which you can sell

That's why you choose FreeBSD

Why do we like FreeBSD?

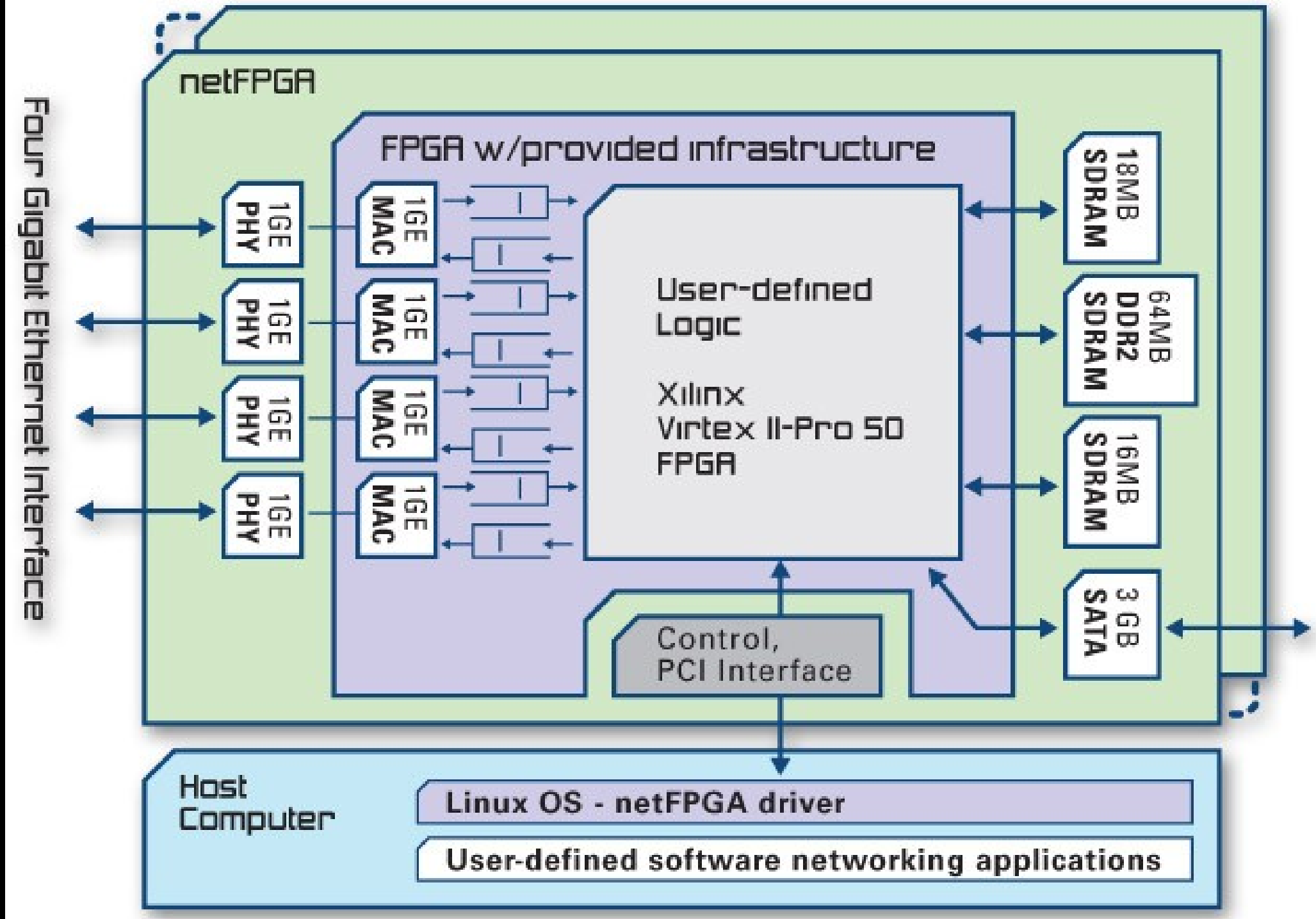
- Free
- Stable
- Secure
- Fast
- Liberal license (good for ***your*** business)


Hardware/software interface
NetFPGA
FreeBSD

Details

NetFPGA card: details

- 4 ports of Gigabit Ethernet
- 2 high speed, serial I/O connectors
- 64MB of DDR2 DRAM, 4.5MB of SRAM
- Fully reprogrammable without additional hardware
- PCI interface


Four Gigabit Ethernet Interface
netFPGA
FPGA w/provided infrastructure
1GE PHY
1GE PHY
1GE PHY
1GE PHY
1GE MAC
1GE MAC
1GE MAC
1GE MAC
User-defined Logic
Xilinx Virtex II-Pro 50 FPGA
18MB SDRAM
64MB DDR2 SDRAM
16MB SDRAM
3 GB SATA
Control, PCI Interface
Host Computer
Linux OS - netFPGA driver
User-defined software networking applications

NetFPGA: 3 puzzles

Firmware: functionality provider

User utilities: for bitstream upload

Kernel driver: low-level glue

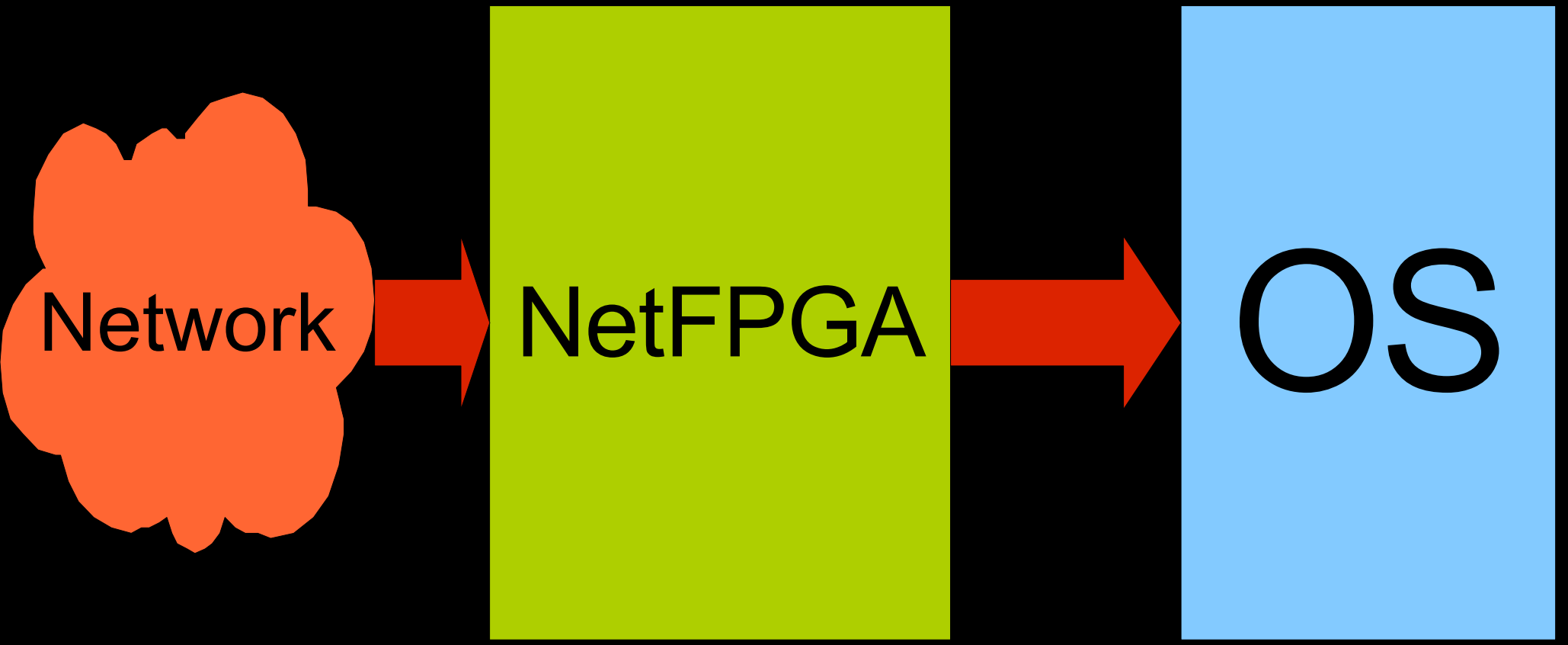
What level we're working on?

Example..

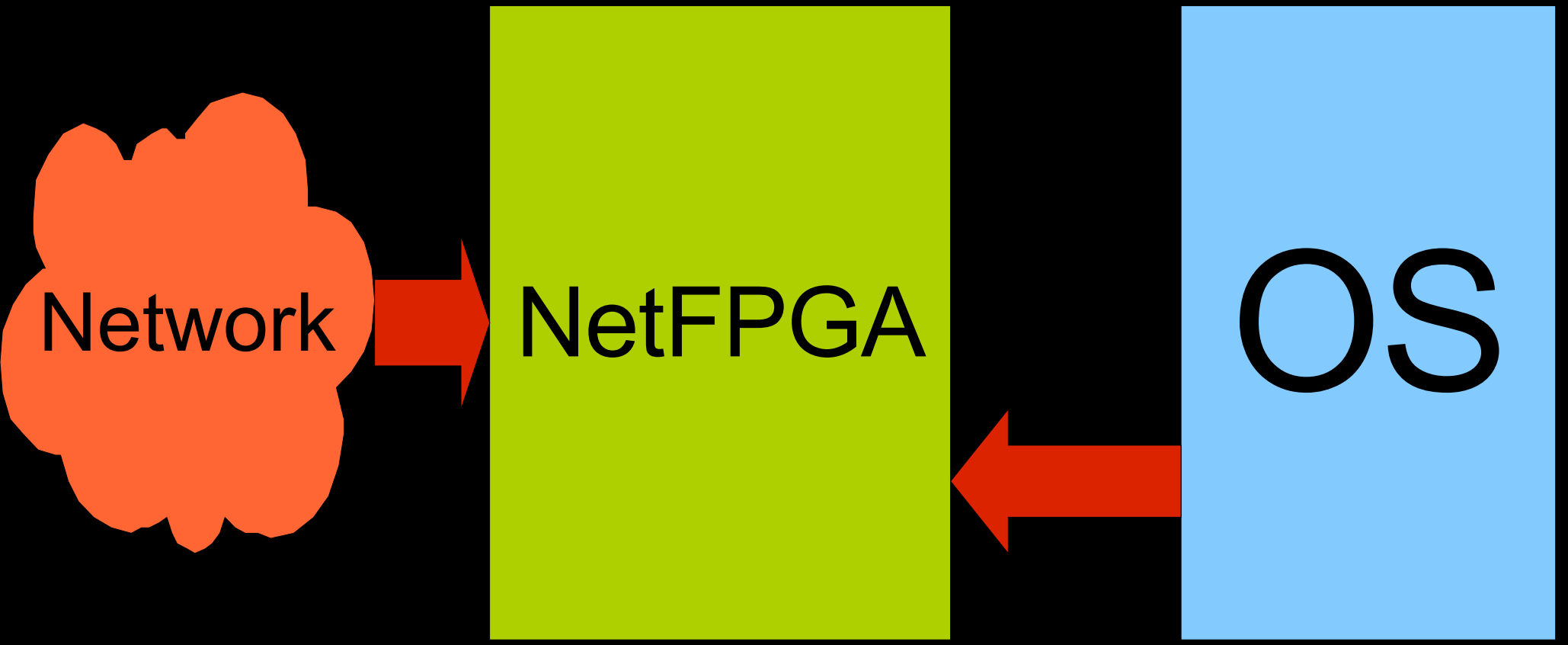
Packet transmission in the NetFPGA world

Data is being sent to the card

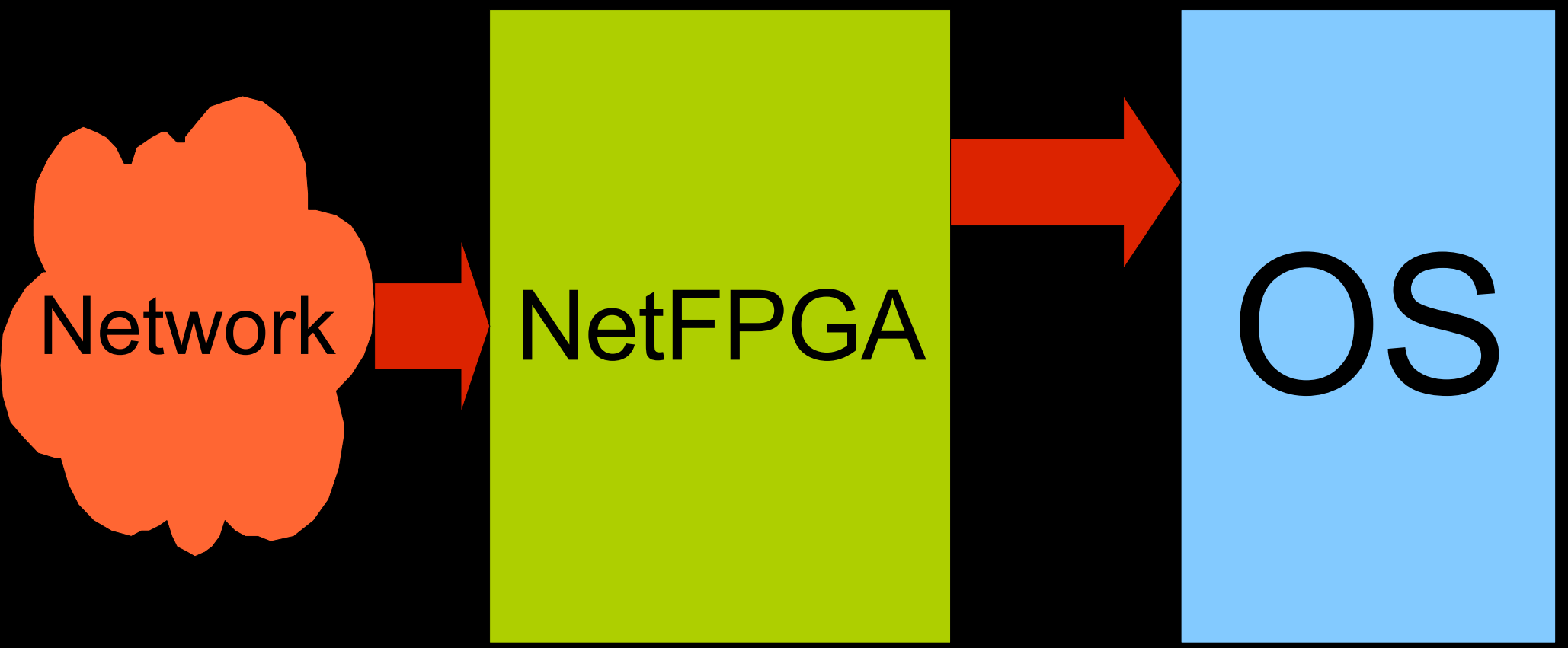
Interrupt is delivered



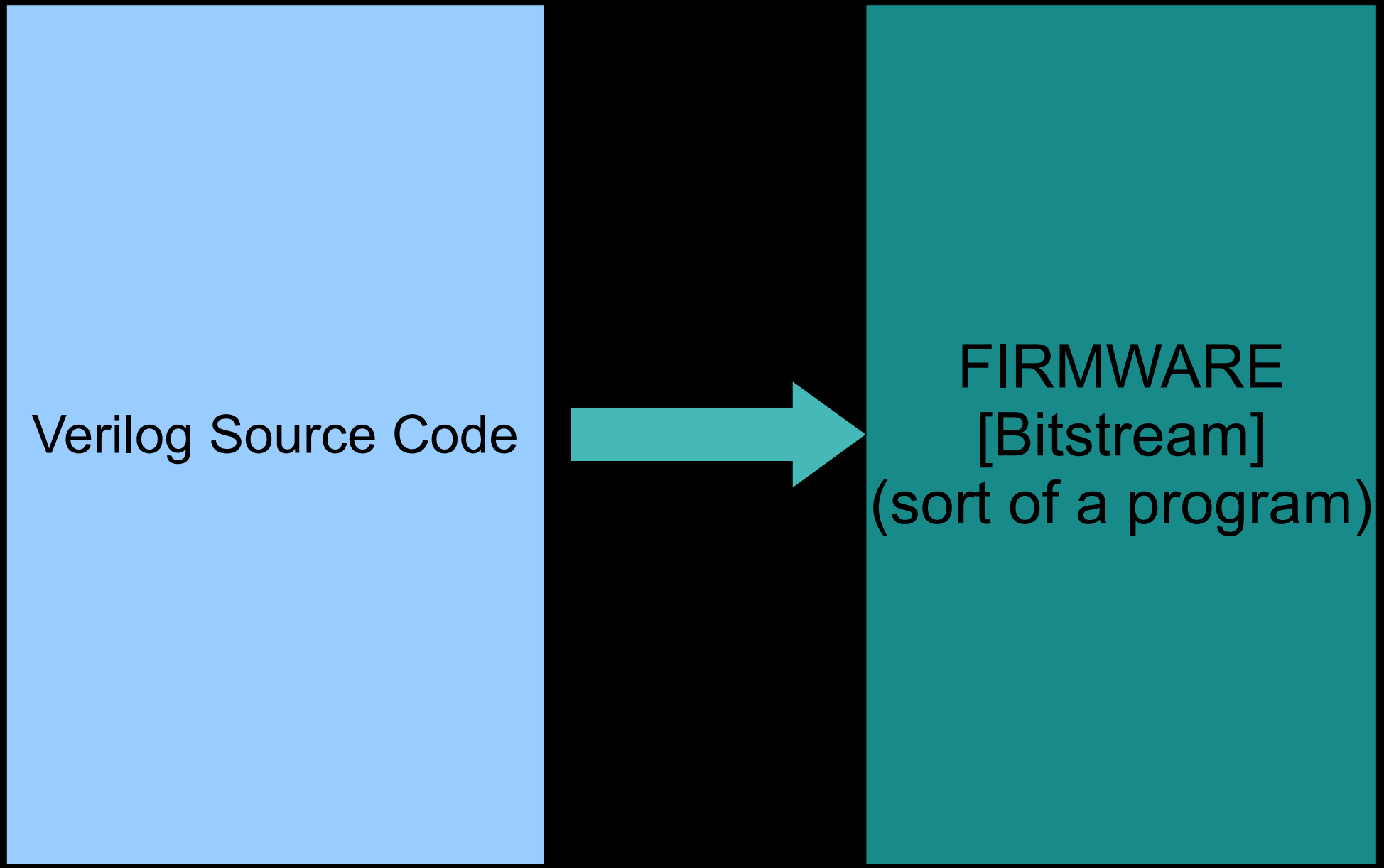
In order to „see”, which port has a data available, you read a register



DMA transfer is started

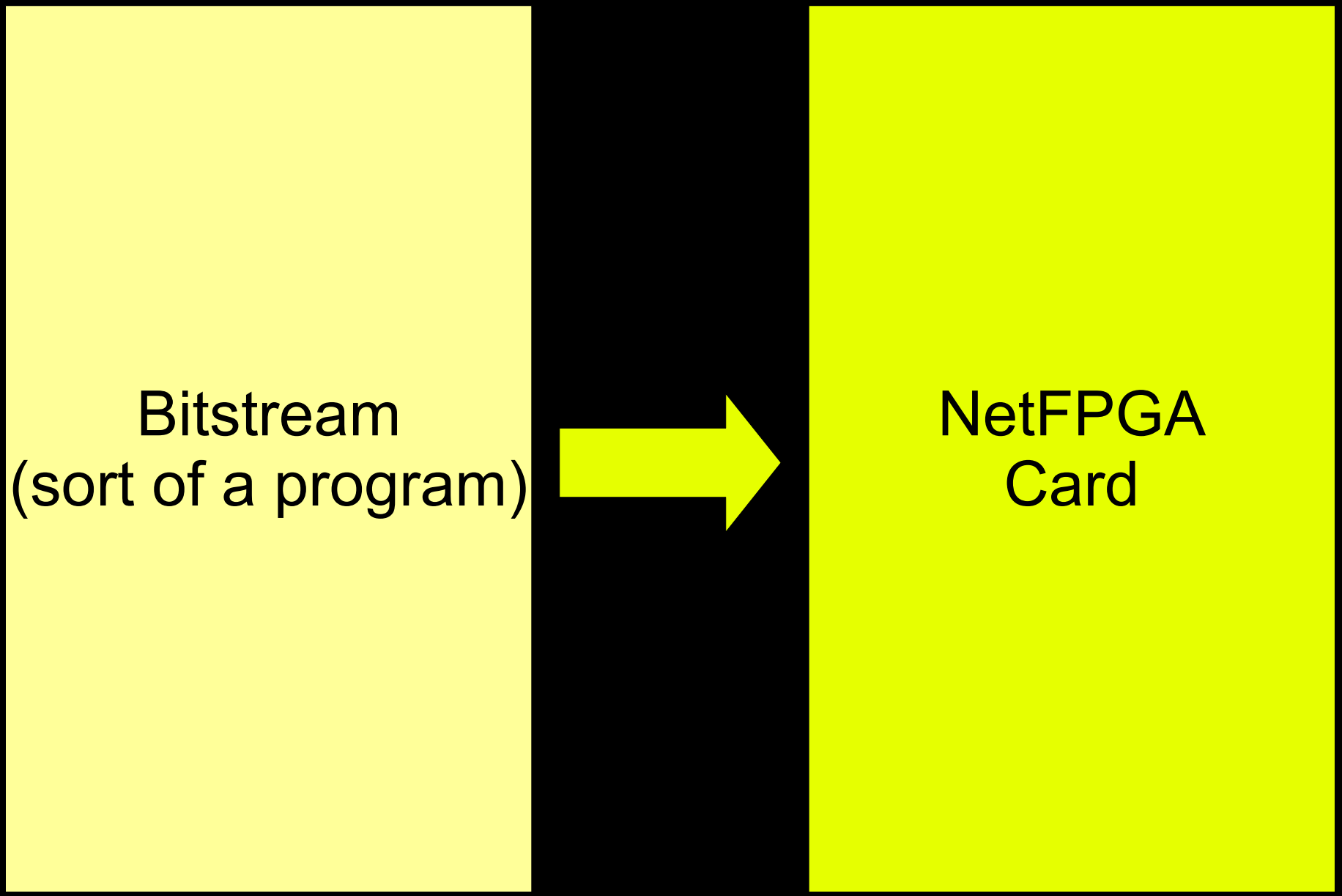


NetFPGA programming


Verilog Source Code
FIRMWARE
[Bitstream]
(sort of a program)

„Bitstream” file has a specific format...

Library for Xilinx Bitstream Files has been implemented


Bitstream
(sort of a program)
NetFPGA
Card

Current utilities in Linux

- Read card's memory chunk
- Write to the card
- Program the card
- Obtain statistics

New utilities had to be implemented

Programming the card from the FreeBSD system is possible now

There is only one tool that lets you to do all the work

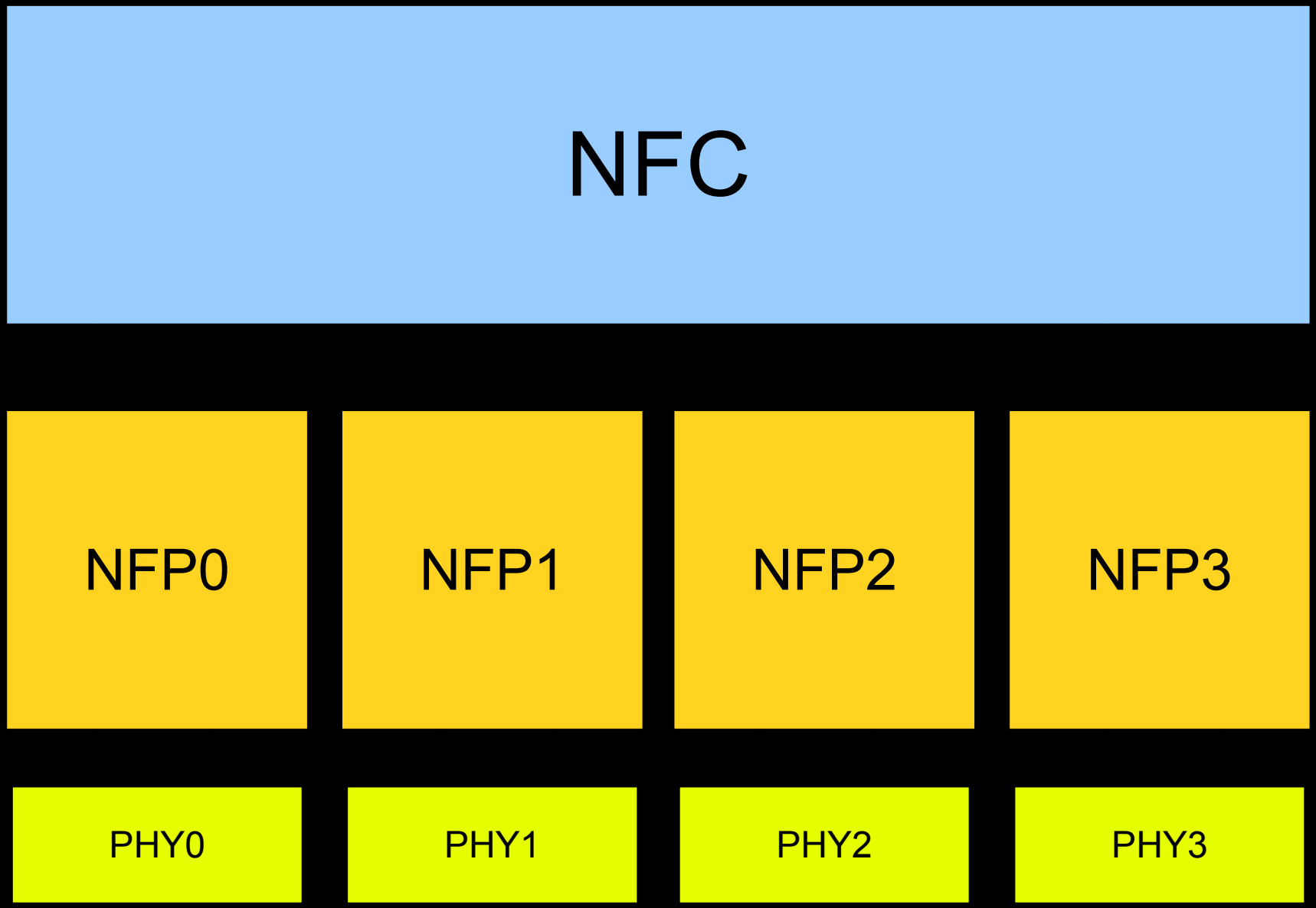
FreeBSD driver design

Driver has 2 parts:

Programming interface

Ethernet interface

NetFPGA Controller and NetFPGA ports handling has been implemented


NFC
NFP0
NFP1
NFP2
NFP3
PHY0
PHY1
PHY2
PHY3

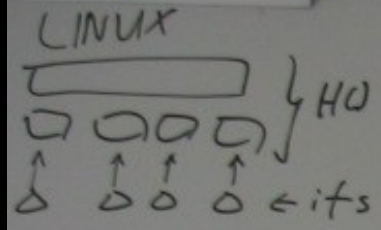
Interface appears automatically in the filesystem, once the device is present in the PC:

/dev/netfpga

Problem..: when driver is loaded, Ethernet interfaces always appear automatically

..even if there's no bitstream

Results



Wojciech goals:

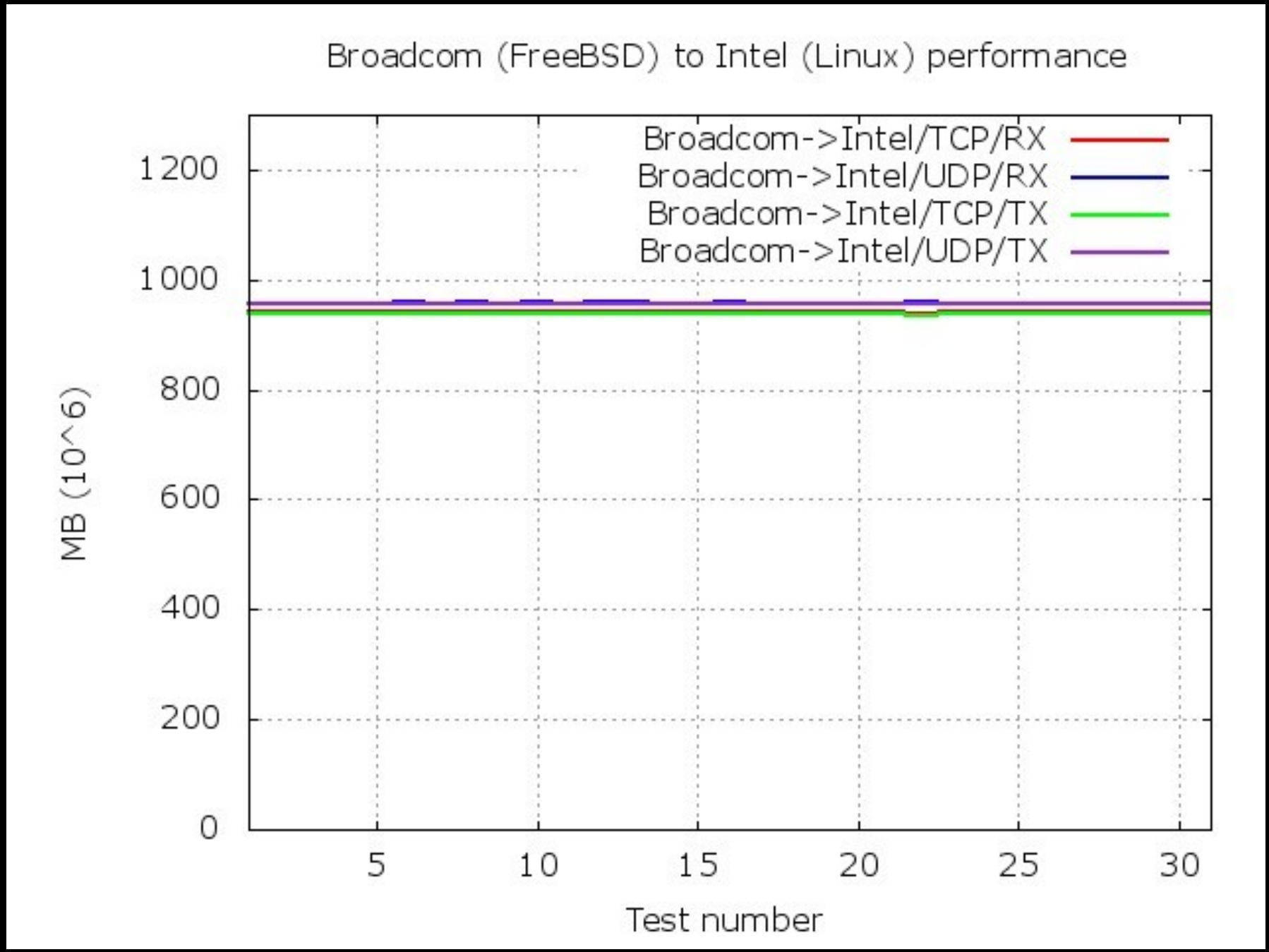
1. Basic FreeBSD ~~driver~~ host mod for NetFPGA
   - NetFPGA PCI visible at FreeBSD address space
   - ability to read and write registers
   - Linux user level command line tools ported / reimplemented
   1.1. Programming of binaries

2. NetFPGA visible as "Ethernet" at FreeBSD
   2.1. Data goes through PCI (less important)
   2.2. Data goes through SATA (more important but may be impossible) BLG FASH
   2.3. Zero-copy receiving "scientific goal"

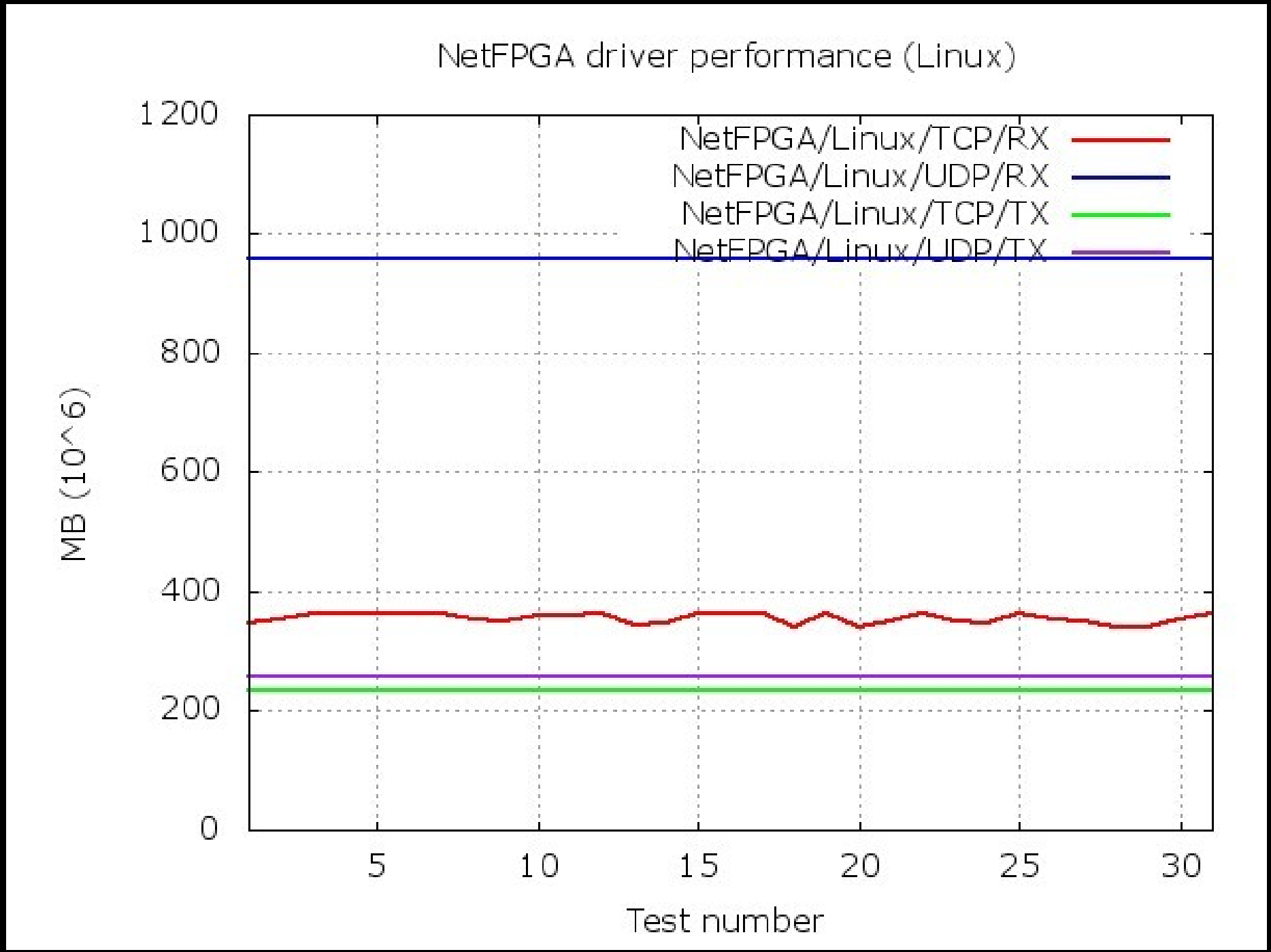
FreeBSD experimental support is here...

- Card is detected and can be programmed
- Programming utilities are here
- Basic network functionality works
  - Ping program is able to transmit/receive packets
  - Basic benchmarking works

Non-NetFPGA performance



NetFPGA performance (Linux)



NetFPGA performance (FreeBSD)

NOT YET :-(

Sorry!

We used 1.2.5
(not so up-to-date)
release of NetFPGA
reference designs

Plans

- Bring NetFPGA support to the FreeBSD source code base
  - Work on stability
  - Work on PERFORMANCE
    - Being better than Linux would be nice!

Project's repository

```
svn co
https://vcs.hiit.fi/svn/psirp/s
rc/netfpga/projects/freebsd_net
fpga
```

This is still Work-In-Progress!

Special THANKS...

- Pekka Nikander
- Jussi Kangasharju
- Bengt Sahlin
- Ericsson and HIIT teams

This presentation will be available on:

http://FreeBSD.czest.pl/~wkoszek/netfpga/

The End

Wojciech A. Koszek
wkoszek@FreeBSD.org
2009.08.27