



An FPGA-Based Emulation Platform For **Optical-Enabled** System

# CPU + IO FPGA 仿真平台

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# New Focus for Intel Labs China: *Advanced Research in Embedded Systems*



# Embedded Systems Research

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Applications

Connected  
Embedded  
Systems

Embedded  
Software

Embedded  
Architecture

Embedded IO

Electronic  
HW/SW Design

Intel® Technologies

Cores, SoC Building Blocks, Video Analytics co-processors,  
MeeGo\*, SW Tools, ...

# Agenda

- Design challenges
- Evaluation methods
- Our approach
- Implementation
- Q&A

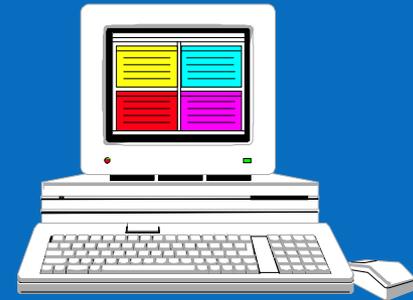
# Design challenges

- Besides the well-known issues:
  - Memory wall
  - Power wall
  - Frequency wall
  - SW productivity
- We must make the system
  - Balanced
    - I/O, CPU and interconnection
  - Efficient
    - Cost, performance



# Evaluation methods

- Simulation
  - Pros: flexible, cost effective, fast turnaround
  - Cons: slow, insufficient model accuracy
- Emulation:
  - Pros: flexible, speed, model accuracy, convincing result
  - Cons: HW resource limited, difficult to scale
- Hybrid-simulation



# Our view and approach

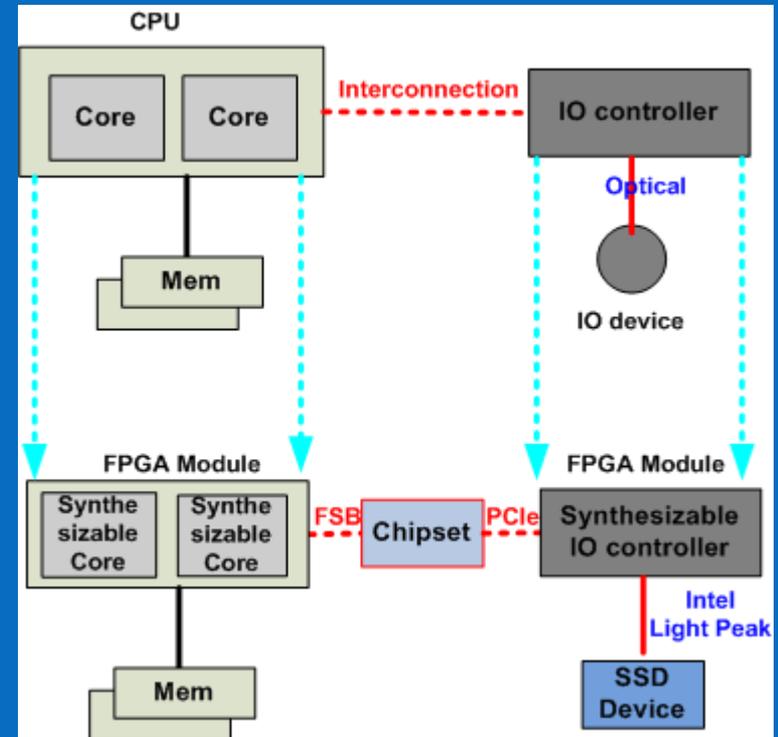
- More and more BW required
  - HD video, data sharing, video conference....
- Electrical cable approaching physical limitation
  - Eye closes at  $\sim 10$ Gbps data rate on FR4 board \*
- I/O will be the next focus for optical technology penetration
  - Discrete chips can be used
  - Optical on-die integration not mature yet
  - Intel announced LightPeak to simplify I/O design



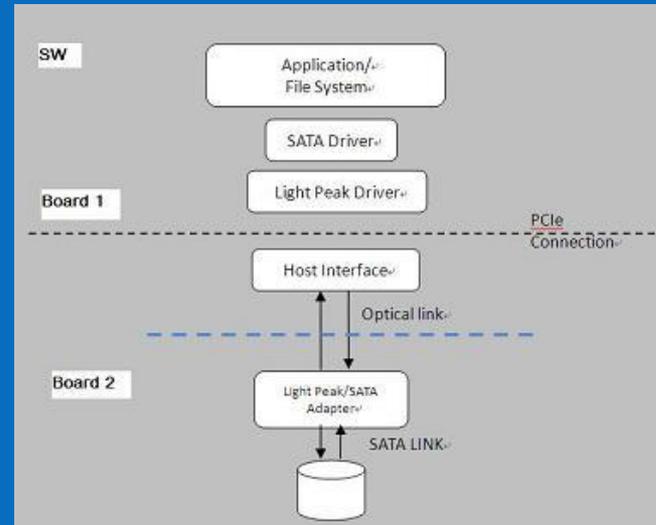
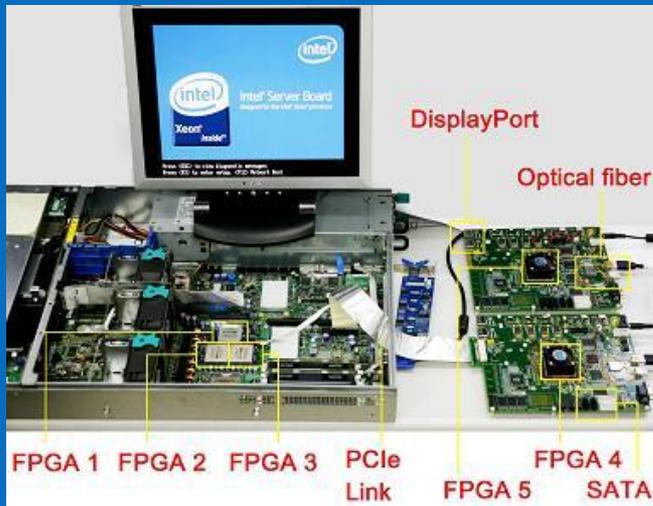
\*Source : Intel

# Our view and approach (Cont.)

- I/O throughput increased to 10+Gbps enabled by optical
  - IO controller? Special offloading engine?
  - Interconnection?
  - uArch of the cores?
  - HW/SW partitioning?
- Research platform needed to explore the huge design space!
- We adopt FPGA emulation approach and implement **core** and **IO controller** in FPGA
  - Flexibility to changes both IO and core



# The Implementation



- SATA SSD as the IO device
- The data and control path: SATA SSD and LPK controller ↔ optical fiber ↔ LPK to PCIe transformer ↔ PCIe cable ↔ motherboard and core

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