ODSA: Optical I/O Chiplet for Heterogeneous Computing
Optical I/O Chiplet for Heterogeneous Computing

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The Case for In-Package Optical I/O

Problem
- Package performance is pin limited
- Power for off-chip I/O increasing and unsustainable

Source: Xeon Cascade Lake, Anandtech April 2019; Source: G. Keeler, DARPA ERI 2019

Problem
- Large energy and bandwidth penalties for short distance data movement
- Restricts system architecture design flexibility
Chiplet for Optical I/O

2 Tbps TeraPHY (75mm²)
Target ASP 10X lower / Bit!

20x 100Gbps Pluggable Transceivers
(each 156mm²)
(3,120mm² total Area)

Optical I/O requires denser, lower latency, and lower power technology than currently in the market
Ayar Labs Optical I/O Architecture

**Organic package/interposer**
- **CPU/GPU/FPGA/ASIC**
- **TeraPHY CMOS Optical I/O chip**
- Up to 2km reach optical links via Single Mode fiber
- CW light supply via Single Mode fiber
- SuperNova multi-wavelength source

**Organic package/interposer**
- **CPU/GPU/FPGA/ASIC**
- **TeraPHY CMOS Optical I/O chip**
- Electrical I/O
- Typical in-package temperature 80-110°C
- CW light supply via Single Mode fiber
- SuperNova multi-wavelength source

1000x the bandwidth density at 1/10th the power and latency of copper, and at distances of up to 2km
Industry First Optical Chiplet
Terabit Link Demonstration for Chip-to-Chip Connectivity

- Error free, full-duplex 128 Gb/s per optical port
- TeraPHY™ chiplet with 8 WDM optical channels per optical port
- Powered by our remote SuperNova™ light source
- Total bandwidth of 1.024 Tbps
- Less than 5 pJ/bit energy efficiency
Optical I/O can Redefine the CPU “Socket”

Past

![Intel Xeon Phi 8 Billion Transistors]

Present

![AMD’s 64-core EPYC CPU ~40 Billion Transistors]

Future with Optical I/O

![The Rack is the Socket 20+ Trillion Transistors]

CPU’s are many compute cores and functions wrapped in a power efficient, low latency, high bandwidth interconnect. Optical I/O has these characteristics but with extended reach.
Call to Action

- ODSA/BoW meeting every Wednesday at 9:00 AM
- ODSA/BoW Spec will be released by end of the year
- Check ODSA/wiki page at
  - [https://www.opencompute.org/wiki/Server/ODSA](https://www.opencompute.org/wiki/Server/ODSA)

- More information please contact us
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