Breaking the Boundary between Optical Communication and Data Processing

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Communication

HyPPI: Interconnect Option

Photronics (Signal Propagation)
- Diffraction Limited
- Large Footprint
- Low LMI
- Long Propagation

Plasmonics (Signal Manipulation)
- No Diffraction Limit
- Energy Efficient
- Short Propagation

Motivation

Optics & Photonics Widely Used
- 100 km
- 100 m
- 1 m
- 1 mm
- 1 μm

Electronics Widely Used
- SPEED: 1000 GHz
- Width: 1 mm

Scaling Law

HyPPI: Interconnect Option

Computation

Fundamental Scaling; Building Laws

O-Router: Hybrid Broadband Router

Modulator: Optical Transceiver

Device Integration

Chemical Evolution Figure of Merit

Breaking the Boundary

Integrating HPP Devices into Networks

- Simplify the network architecture
- Broadband over 100 nm
- Support WDM with multiple wavelength
- Each node is non-blocking
- No O-E-O conversions needed for routing

HyPPI improvements

HyPPI: Interconnect Option

This universal metric termed Capability to Latency Energy Amount Resistance (CLEAR) is:
- A holistic set of performance parameters covering both physical and economic factors
- Able to post- and predict the evolution rate
- Valid among different technology cycles

Papers (partial list)
- A. Mehrabian, S. Sun et al., Optical Express (submitted)
- R. Wang, et al., Nanophotonics (under review)
- S. Sun, et al., IEEE Transactions on Electronic Devices (under review)

Hybrid Photonic-Plasmonic Interconnects (HyPPI) with intrinsic and extrinsic modulation options
- Double-Band Hybrid Photonic-Plasmonic Broadband Switch based Non-blocking Optical Routing Design
- Reconfigurable Optical Co-processor
- Modulator: A Dual-Function Optical Modulator-Detector for On-Chip Communication (submitted)
- Resilient Number System Arithmetic based on Integrated Nanophotonics (submitted)