

Photonics in ULSI-based system

Yoshio Nishi, EE

Where would photonics be?

- Back plane to board
- Board to chip
- Chip to chip
- On-chip

Convergence of Optics & Electronics

Nature of Electrical/Optical Components

- **Photons are good for communication; electrons are good for computation and control**
- **Electrical/optical components for Personal Internet Products will provide:**
 - Electronic control of optical communication signals
 - EO and OE conversion

Technology push: Solutions beyond copper/low k in silicon based mainstream CMOS

- **Material innovation with traditional scaling may no longer satisfy projected performance requirements**
 - Novel design, packaging and global interconnect solutions needed
- **What are the options?**
 - Optical
 - rf (guided and/or free space)
 - Low temperature
 - 3D Interconnects
 - ???

Key questions for on-chip

Photonics integration at the same level of silicon IC circa circa early 60's?


Does integrated circuits really need photonics solution?

Do we have transmitter and receiver available on silicon based CMOS?

Any possibility at integrated package?

Back- Up Slide

Demand pull: Optical I/O?

- **Optical source modulation rates**
 - above 20GHz doable?
 - with direct modulation?
- **Optical source drive voltages and mating with transistor voltages**
 - 1V or less bias for optical sources?
- **Drive electronics in CMOS for > 10GHz modulation rates**
- **Packaging?**
 - heat sink, ball grid array  where do optical elements reside?
 - at highs speeds want to get rid of two separate packages - how are the chips integrated?