High-performance Optoelectronic Physical Layers in Systems

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Abstract

A number of companies have been developing low-cost very high-performance parallel fiber-based optoelectronic interconnects [1-7] as an alternative to copper-based interconnect solutions. Potential applications include the replacement of parallel electrical interfaces such as SCI [8] and HIPPI-6400 [9]. In addition to copper replacement, the remarkable attributes of this new optoelectronic technology hold promise for future novel system optimization and design.

A typical parallel fiber-optic port consists of 8 data lines each signaling at the rate of 1 Gbps or greater and capable of synchronous transmission over several hundred meters of low-skew [10] ribbon fiber. While such high-density high-bandwidth interconnect technology is attractive for insertion into advanced systems, there is a mismatch between the high signaling rates of low-cost optoelectronic components such as Vertical Cavity Surface Emitting Lasers (VCSELs) and that which is achievable with conventional CMOS circuitry. Future system integration of parallel fiber-optic interconnects requires that a cost-effective bridge be established between these two technologies. Hence an important challenge is to leverage low-cost, high integration CMOS technology and directly interface to parallel fiber-optic transceiver modules.

This talk will describe some of our experiences working with Hewlett Packard as part of an ongoing DARPA-sponsored program to explore the new technology. The USC effort has been building on an existing experimental Gbps fiber-optic physical layer as well as developing a new multi-Gbps high-speed VLSI CMOS host interface [11] for the HP-POLO parallel fiber-optic interconnect module. A follow-on program will explore an increased level of system integration and the possibility of inserting optoelectronic solutions into practical systems on interconnect length scales of less than 1 m. The possibility of using free-space optical interconnects for very short links will also be discussed.

References