Towards faster, secure and more energy efficient optical networks

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A rapid penetration of multimedia into our lives has triggered unparallel demand for high speed Internet access and secure reliable and very efficient data transport. To satisfy these demands will require new and innovative approaches. It is becoming more clear that electronics alone will not be able to offer the needed solution. Today we already benefit from advances which revolutionized data and voice communications. The implementation of optical transport layer became the backbone of today's high performance networks. Optical fiber offers enormous transport capacity and is capable to accommodate the growing volume of voice and data traffic. Further more, the capacity of each fiber can be further augmented. Today commercially deployed Dense Wavelength Division Multiple Access (DWDMA) networks are capable of transporting tens of Gigabits of data per second over a single DWDM wavelength channel, offering tremendous aggregate data throughputs exceeding ten Terrabits/sec. This creates new communications bottleneck at the fiber endpoints where the routing and switching takes place. Today's routers use electronics to process and route incoming optical data packets. These electronic crossbars, however, do not provide sufficient capacity to timely, efficiently, and without any delays route terabits of incoming data traffic. The switching speed of these devices is limited by the frequency response of used materials and can not any more support desired bandwidth. Given all the above, it seems unlikely that electronics will deliver the needed bandwidth to support existing fiber capacity. We need to look for alternative solutions. There is growing believe, that all-optical switching/signal processing may offer the needed solution. We will review some of the promising approaches which if successfully implemented could result in manufacturable ultra-fast optical devices. We will attempt to predict the applicability of such devices for different applications within existing and newly emerging markets.