

The Rising Role of Photonics in Today's Data Centres

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ABSTRACT

In light of the rapidly increasing demand for ultra-high speed data transmission, data centres are under pressure to scale to provide ever increasing data transmission through their networks, while at the same time improving the quality of data handling in terms of reduced latency and increased channel speed for users. In fact, Cisco Systems estimate that global data centre IP traffic is forecast to reach 7.7 Zetabytes/year by 2017 - 69% of which will be cloud computing traffic - from its present level of 2.6 Zetabytes/year. This amounts to a compound annual growth rate of 25%. However, present electronic switching technology using current data centre architecture is becoming increasingly difficult to scale resulting in electronic bottlenecks despite improvements in data management. In addition, the already significant power consumption of data centre switching and cooling will grow rapidly with data network throughput resulting in sustainability problems in fuel costs and carbon emissions compliance. Furthermore, the point is being reached where the power density of devices is becoming so great that providing adequate cooling will present an intractable problem that could potentially result in a greatly increased risk of thermal runaway and system reliability problems. In effect, device thermal density has become a limiting design criterion threatening to bring Moore's law to an end. There is therefore the need to develop an alternative technology to move toward a solution to this impending problem. Photonic technologies show promise in significantly reducing power consumption in both switching and cooling systems while at the same time greatly improving switching speed. In this paper we will discuss power consumption and scalability issues, and the ultimate need for all-optical solutions; explore the tremendous bandwidth potential of optical fibre based networks; and review alternative photonic technologies. Finally, progress in the form of a novel and highly scalable optical interconnect will be reviewed.