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PhD Dissertation Announcement

Design and Analysis of Dense Wavelength Division Multiplexing Routers

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Dense Wavelength Division Multiplexing (*DWDM*) allows hundreds of wavelength channels to be carried in a single optical fiber, at the rate of 40 Gb/s and beyond, and is the most promising solution for the next generation networks. However, an all-optical-packet switched *DWDM* network cannot be practically realized due to limitations on optical technologies. We presented a DWDM multimode router architecture, which supports electronic packet switching, optical circuit switching, and optical burst switching modes on the same router platform. The multimode router is capable of dynamically reconfiguring wavelengths to operate in the desired switching modes. This approach allows short messages to be switched electronically using packet switching, while allowing majority of the data transfer (e.g. video) to pass core routers optically. It greatly reduces the need for expensive Optical/Electrical/Optical (O/E/O) converters.

In this work, we present the design and analysis of the multimode router architecture. We analyzed the cost, performance, and energy consumption of the multimode router. More specifically, we developed an analytical cost model to show that the multimode router is cost effective across a wide range of technology factors. A novel dynamical resource allocation method called ***P****redictive* ***N****eed-base****d*** ***O****ptimized* ***R****esources* ***A****llocation* (*PNdORA*) was proposed. The scheme predicts the need of each optical port in the future time frame, and allocates O/E/O converter pairs in real-time. Results have shown this method improves the performance of the multimode router, by several orders of magnitude, under abruptly varying traffic. We developed an energy consumption model of the multimode router, and compared it with existing models. Our results confirm that electronic packet switching consumes most energy per bit. We proposed the use of MEMS actuated mirrors in the optical switching fabric, since they consume far less energy than any other optical switching fabrics such as the Arrayed Waveguide Grating (AWG) optical switch. We have evaluated the energy consumption of the multimode router under varying load conditions and compared it with the AWG models. Our results indicate that by deploying MEMS-based switches, a highly scalable, energy efficient multimode router can be designed. We show that by deploying the strengths of electronic packet switching, optical circuit switching, and optical burst switching, the multimode router is a cost effective candidate for the future bandwidth needs while having a low carbon footprint.

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