Dynamic Wavelength Allocation in Optical Networks *

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We propose algorithms for allocation of wavelengths to connections (lightpaths) in WDM networks, that is, optical wavelength division multiplexed networks. We investigate mainly ring and tree networks. The worst-case situation is considered since we investigate the case were no blocking is allowed. Also, there are no assumptions on the traffic arrival and holding times. The traffic is characterized only by its *load* L, which is the maximum number of lightpaths that can be present on any link assuming no blocking.

For a static scenario, and with networks without wavelength conversion, and prove that the known algorithm which requires $2L-1$ wavelengths is optimal. For a dynamic scenario we show first that shortest path routing produces a routing which has at most twice the load of the optimal solution. We also show that at least $0.5L\log_2 N + L$ wavelengths are required by any algorithm for rings of N nodes if no conversion is used. We then present an algorithm that uses at most $L\log_2 N + L$ wavelengths for rings and $2(L-1)\log_2 N$ for trees. For rings, we show that the known ***First-Fit*** algorithm requires at most $2.53L\log_2 N + 5L$ and at least $0.9L\log_2 N$ wavelengths.

When limited wavelength conversion is allowed, we first show that expanders can be used to ensure no blocking in arbitrary topologies. We define the *conversion degree* as the number of wavelengths to (one of which) a wavelength can be converted. (A network with no conversion has conversion degree 1.) Then we present conversion patterns for rings with conversion degree $d = 2$ which require $L\log_2 L + 4L$ or $2L\log_2\log_2 L + 4L$ wavelengths, thereby eliminating the dependence (in the no-conversion case) of the number of wavelengths on N. In a different traffic model where lightpaths are never taken down the number of wavelengths needed is shown to be only $\max\{0, L-d\} + L$ for a conversion degree of d.

*The work of O. Gerstel, G. Sasaki, and R. Ramaswami was sponsored in part by DARPA grant MDA-972-95-C-0001.

1997 PODC 97 Santa Barbara CA USA