Considering transmission impairments in RWA algorithms

Considering transmission impairments in Routing Wavelength Assignment algorithms

R. Cardillo, V. Curri, M. Mellia

Dipartimento di Elettronica, Politecnico di Torino, C.so Duca degli Abruzzi 24, 10129, Torino , Italy
Email: *vittorio.curr@polito.it*

ABSTRACT

We face the Routing and Wavelength Assignment problem considering as constraints the physical impairments that arise in all-optical networks. We propose a simple model for the physical layer considering both static and dynamic impairments. It is based on simulation of signal propagation in order to characterize each lightpath with a reliability parameter.

1. INTRODUCTION

Wavelength Routed (WR) networks are considered the best candidate for the short-term implementation of a high-capacity IP infrastructure. In WR networks, remote routers are connected through *lightpaths* that may extend over several physical links. Lightpaths can either be semi-permanent [1], or dynamically allocated [2]. In the first case a static topology is seen at the IP layer, in the second case we obtain more adaptivity.
We consider a dynamically set-up transparent optical network. When solving the Routing Wavelength Assignment (RWA) problem, we take into account the impairments imposed by the physical layer. We consider the effect of *nonlinearities* associated to dynamic wavelength allocation on optical fibers.

2. MODEL OF PHYSICAL LAYER

In order to analyze the evolution of the signals through a transparent optical network based on the WDM technique, the wave equation for propagation should be solved for every optical link, together with models of optical components. Due to the nonlinear nature of the problem a rigorous analysis could need hundreds of hours of CPU time. To overcome the computational limits we approximate the analysis estimating the goodness of a lightpath through the related *Optical Signal-to-Noise Ratio* (*OSNR*) and its penalties due to linear and nonlinear propagation effects. *OSNR* penalties are derived using semi-analitical models of impairments (PMD, dispersion, SPM and XPM [4]) based on simulations. Main approximation is given by the separation of effects.

3. APPLICATION OF RWA ALGORITHMS

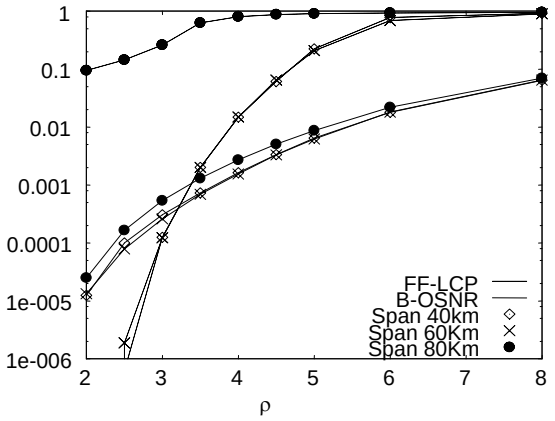
To solve the RWA problem, we propose a novel algorithm, called *Best-Optical Signal* Noise Ratio (B-OSNR), which jointly assigns to a given request a path and a corresponding wavelength. In particular, the path/wavelength solution which will present the maximum *OSNR* will be selected. We considered as physical topology derived from a possible evolution of the *Telecom Italia Spa* network. Figure plots the average blocking probability versus offered load.

ACKNOWLEDGEMENTS

This work was supported by the Italian Government within the ADONIS project and by the EU within the E-Photon-ONE FP6 NoE. The authors would like to thank RSoft Design Group, Inc for supplying the simulation tool OptSim®.

REFERENCES

[1] B .Mukherjee *et al* ACM/IEEE Trans. on Networking, Vol.4, n.5, pp. 684-695, Oct. 1996.
[2] H .Zang *et al* IEEE Comm. Mag., Sep 2001.
[3] G. P. Agrawal, *Nonlinear fiber optics*, A.P., 1989.
[4] H. Zang *et al* SPIE Opt. Net. Mag., Jan. 2000.



Blocking probability versus load for different algorithms. Fiber span L_{span} of 40 km, 60 km, 80 km.