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TRAFFIC GROOMING OPTIMIZATION IN MESH WDM NETWORKS WITHOUT WAVELENGTH CONVERTER

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Abstract. This is a tutorial paper on the traffic grooming optimization in mesh Wavelength Division Multiplexing (WDM) networks for static traffic patterns. The traffic grooming technique provides a two-layer traffic engineering capability by aggregating and routing low-bandwidth traffic flows from the upper layer over re-configurable high-bandwidth connections in the lower layer. This paper demonstrates how to use the Lagrangian Relaxation and Subgradient Methods (LRSM) to solve the optimization problem over a mesh WDM network where no wavelength converters are used, i.e., a lightpath must use the same wavelength from its source to destination. The framework makes use of a constrained Integer Linear Programming (ILP) formulation. The outputs of our optimization include the selection of profitable traffic flows, the routing schemes for the selected traffic flows over lightpaths, the selection of lightpaths, and the Routing and Wavelength Assignment (RWA) schemes for the selected lightpaths. Some interesting observations are noted.

Keywords. Network optimization, lagrangian relaxation and subgradient methods, traffic grooming, WDM networks, wavelength continuity constraint.

AMS (MOS) subject classification: 90B18

1 Introduction

We study the static traffic grooming problem in mesh WDM networks. It is a joint two-layer traffic engineering problem: the selection and routing of lightpaths over fibres, and the selection and routing of traffic flows over lightpaths. General surveys of the optimization models and methods can be found in [1 - 4]. Static traffic grooming in mesh networks is challenging and is reported in only a few publications [5 - 13]. The lightpath RWA problem was neglected in [7, 8, 10]. Heuristic algorithms were proposed in [6, 11 - 13]. In [5], a decomposition method was given with the objective of minimizing the total number of transponders, but it is unclear how the decomposition