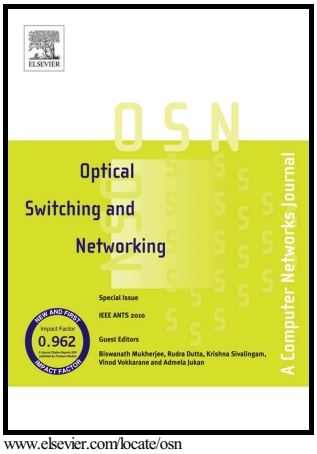
Architecture and Performance of Grouped ROADM Rings with Shared Optical Amplifier and Grouped Add/Drop Ports for Hybrid Data Center Network

Li Zhao, Weisheng Hu, Xiaojian Zhang



www.elsevier.com/locate/osn

PII: S1573-4277(16)30073-X
DOI: http://dx.doi.org/10.1016/j.osn.2016.08.002
Reference: OSN417

To appear in: *Optical Switching and Networking*

Received date: 8 May 2015
Revised date: 6 June 2016
Accepted date: 15 August 2016

Cite this article as: Li Zhao, Weisheng Hu and Xiaojian Zhang, Architecture and Performance of Grouped ROADM Rings with Shared Optical Amplifier and Grouped Add/Drop Ports for Hybrid Data Center Network, *Optical Switching and Networking,* http://dx.doi.org/10.1016/j.osn.2016.08.002

Architecture and Performance of Grouped ROADM Rings with Shared Optical Amplifier and Grouped Add/Drop Ports for Hybrid Data Center Network

Li Zhao[1], Weisheng Hu[1*], Xiaojian Zhang[2]

[1]State Key Laboratory of Advanced Optical Communication Systems and Networks, Department of Electronic Engineering, Shanghai Jiao Tong University, Shanghai 200240, China

[2]Global Energy Interconnection Research Institute, Nanjing 210003, China
cissy_sunshine@sjtu.edu.cn
[*] *wshu@sjtu.edu.cn*
zhangxiaojian@epri.sgcc.com.cn

Abstract
We propose a novel reconfigurable optical add drop multiplexer (ROADM) rings architecture for the hybrid data center network where a pair of optical amplifiers is shared in a maximum number of ROADMs group to reduce cost. We show through simulation that the network proposal can almost achieve the same bit error rate performance of the conventional rings network with fully installed optical amplifiers, and 50% of optical amplifiers can be saved. The narrowing effect of cascading wavelength selective switches limits the number of ROADMs in such architecture to 54 regardless of the number of optical amplifiers provided. Based on those results, an ROADM with grouped add/drop ports is also proposed to further increase the capacity of network, which is 4 fold of the original ROADM rings architecture.

Keywords: Hybrid electrical/optical network and data center; ROADM rings architecture design; unidirectional ring simulation; bit error rate.

1. Introduction

Data center is the core part of today's information infrastructure, and is growing to mega size with more than thousands of racks and millions of servers [1-4]. In order to connect those amounts of racks and servers, quite a large number of electrical switches are used to construct the data center networks in such non-blocking architectures as Fat trees [5], DCell [6], and BCube [7]. The problem is that both cost and complexity increase exponentially as the size of data center increases, and the cabling and power consumption become un-resolvable burdens. It is reported that both mice and elephant streams coexist in the data center, and the latter is growing to be predominant, optical circuit switch was employed to deliver the elephant streams in a less cost and power consumption way [8-12]. As a result, a hybrid switching architecture is a better choice, in which the electric packet switch delivers all-to-all bandwidth for the bursty portion of traffic, and the optical circuit switch (OCS) handles the baseline and slowly changing communication. Another benefit employing OCS is that it allows a data center to be established over larger area.

There are several ways to construct the optical circuit switch in the hybrid switching architecture. One most straightforward way is to use the micro-electro-mechanical-system (MEMS) switches to connect all the top-of-rack (ToR) switches directly [8-9], but the cabling will become a critical issue if multiple MEMS switches are scaled in a non-blocking way. To reduce cabling complexity, the second way is to use reconfigurable optical add/drop multiplexer (ROADM) which uses wavelength selective switch (WSS) to drop the