Journal of the Optical Society of Korea, Vol. 11, No. 4, December 2007, pp. 149-152

Simple and Efficient Management Scheme for EDFA in WDM Systems

Mumtaz Ali, M. Shoaib Khaliq, A. Sattar, and Seoyong Shin*

Department of Communication Engineering, Myongji University, Yongin, Kyunggi-Do, Korea

(Received November 8, 2007)

We present a simple and efficient management scheme for gain control of EDFA by using standardized network management protocol (Simple Network Management Protocol) and operating the optical amplifier in a link-control scheme. We have demonstrated the proposed scheme by using SNMP Simulator and optical simulation software package.

OCIS codes : 060.0060, 060.2320, 060.4250

I. INTRODUCTION

During the last decade a remarkable spreading of the high level management technologies, principally the network management, was noticeable in the optical networks [1-3]. An important issue in this regard is to manage the different network elements efficiently by means of common standardized protocols. Simple Network Management Protocol provides the necessary network management functions (configuration, performance, fault, security, accounting and safety) [4]. The goal of this paper is to describe a management solution, in terms of efficient communication between an SNMP manager and its agent by using Management Information Base (MIB) and EDFA's link-controller (implemented in Matlab simulation software).

The rest of the paper is organized as follows. In Section II, we introduce the standardized protocol SNMP and discuss its role and format. In Section III, we explain our proposed management scheme by showing the block diagram. In Section IV, we explain our simulation setup and its results. In Section V, we concluded the proposed management scheme.

II. SIMPLE NETWORK MANAGEMENT PROTOCOL (SNMP)

SNMP was designed to be an application-level protocol that is part of the Transmission Control Protocol/ Internet Protocol (TCP/IP) protocol suite. It is intended to operate over the User Datagram Protocol (UDP). Fig. 1 provides a closer look at the protocol context of SNMP. From a management station, three types of SNMP messages are issued on behalf of a management application: *GetRequest*, *GetNextRequest*, and *SetRequest*. All three messages are acknowledged by the agent in the form of a *GetResponse* message, which is passed up to the management application. In addition, an agent

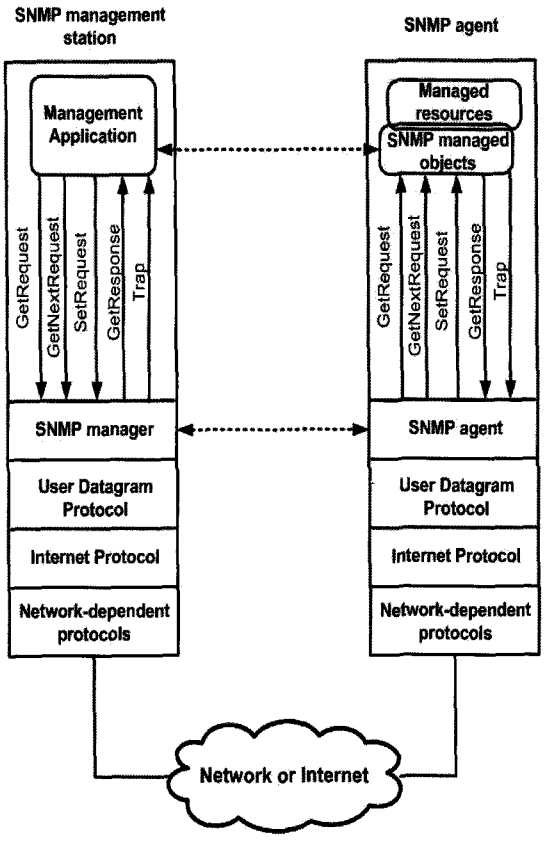


FIG. 1. The Role of SNMP.

may issue a trap message in response to an event that affects the Management Information Base (MIB) and the underlying managed resources [5].

SNMPv2 (version 2) defines seven types of messages, known generically as Protocol Data Units-PDUs, as shown in Table 1. The format of the PDU is shown in Fig. 2 [6].

III. MANAGEMENT SCHEME BLOCK DIAGRAM

Fig. 3 shows the block diagram of the suggested EDFA gain management scheme. SNMP manager manages the EDFA by allowing the user to set channel add/drop information. A manager includes a management-information base (MIB) [4], which is a database of a network element and contains a set of variables to be managed. SNMP agent gathers add/drop information about the EDFA channels and forwards it to the database. EDFA link-Controller (implemented in Matlab software) uses the database information and adjusts the power of the control channel, Optical Supervisory Channel (OSC), in order to hold constant the total input power of the signal channels and the control channel of the EDFA [7]. This block works as the variable optical attenuator (VOA) for OSC power control. The gain of the EDFA for all incoming channels is constant even when there is a reconfiguration of the network or an add-drop or loss of signal channels [8]. WDM System in Fig. 3 contains the optical sources (channels 1-8), OSC source, VOA, multiplexer, optical amplifier (EDFA) and optical signal analyzer for channels' gain monitoring.

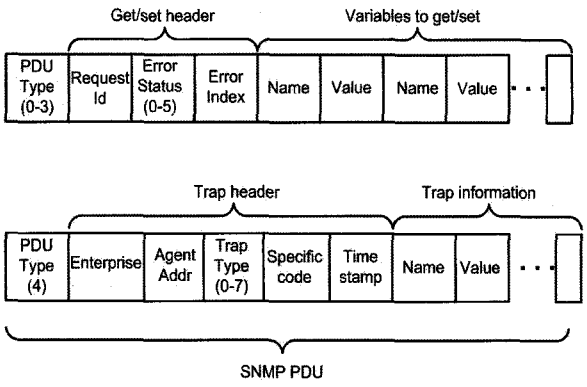


FIG. 2. SNMP Protocol Data Unit (PDU) format.

IV. SIMULATION AND RESULTS

We have performed the simulation by implementing three different areas in an efficient manner in order to get better results. Firstly, for SNMP simulation we have programmed and implemented the MIBs for manager and its agent specific to add/drop channel SET operation. Secondly, for VOA functionality as per channel add/drop information in the database we have used the MATLAB software in order to efficiently communicate with Optsim™ and to generate the controlled OSC signal. Finally, we have implemented the WDM system

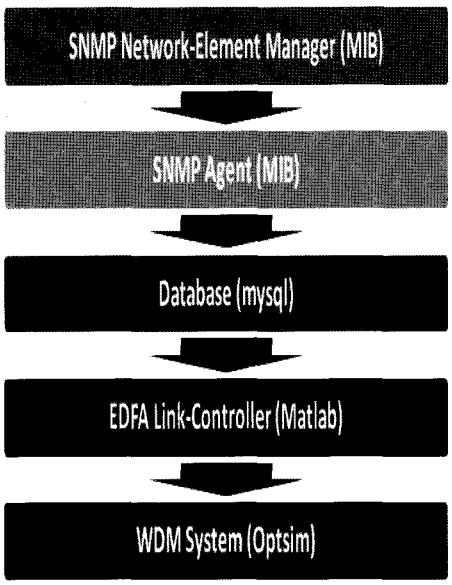


FIG. 3. Block Diagram of the proposed manag-ement scheme of EDFA. MIB: Management Information Base.

TABLE 1. SNMPv2 PDU types

SNMPv2 PDU Type	Sender-receiver	Description
GetRequest	Manager-to-Agent	Get value of one or more MIB object instances
GetNextRequest	Manager-to-Agent	Get value of next MIB object instance in list or table
GetBulkRequest	Manager-to-Agent	Get values in large block of data, for example, values in a large table
InformRequest	Manager-to-Manager	Inform remote managing entity of MIB values remote to its access
SetRequest	Manager-to-Agent	Set value of one or more MIB object instances
Response	Agent-to-Manager or	Generated in Response to
	Manager-to-Manager	GetRequest, GetNextRequest, GetBulkRequest, SetRequest PDU, or InformRequest
SNMPv2-Trap	Agent-to-Manager	Inform manager of an exceptional event

TABLE 2. Configuration of components in Optsim™

Parameter	Value
No. of Channels	08
Wavelength range	1550-1555.6 nm
Each channel input power	-20 dBm
EDFA simulation mode	Giles_params [9]
EDF length	20m
Pump Power and wavelength	30mW and 980 nm
OSC wavelength	1560 nm

TABLE 3. Observations from Optsim™.

Parameter	Observations
OSC power (output of VOA)	No of channels dropped: 01 dropped =-33.01dBm 03 dropped =-30.45 dBm

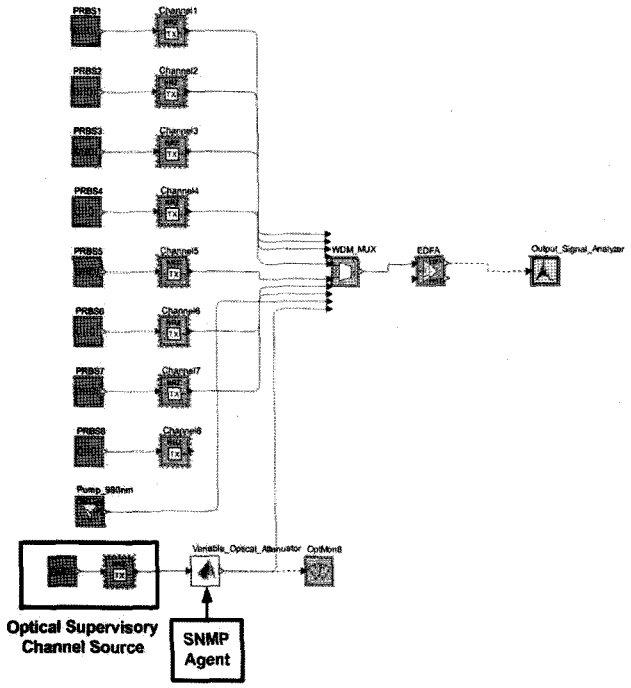


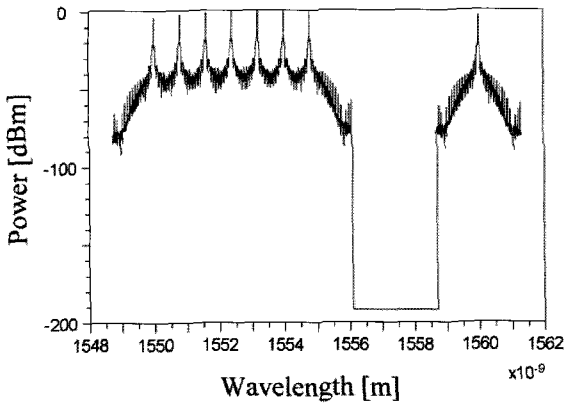
FIG. 4. Simulation Setup of WDM System in Optsim™.

(as shown in Fig. 4) by using Optsim™ having configuration of components shown in Table 2.

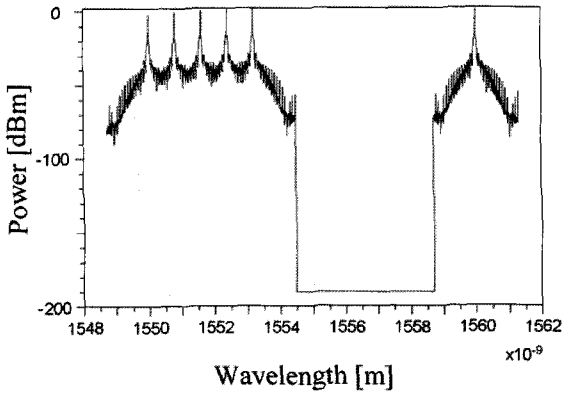
We have simulated the above implemented system in two cases i.e. dropping 1 and 3 channels. It is observed from Table 3 and Fig. 5 that the output of EDFA have the same gain on surviving channels by increasing OSC power.

V. CONCLUSION

In this paper, we have shown the implementation



(a) 1 channel dropped.



(b) 3 channels dropped.

FIG. 5. Simulation Results.

and simulation of simple and efficient management scheme for gain control of EDFA in WDM systems. This efficient scheme is also useful for other management requirements and other WDM components [4].

ACKNOWLEDGEMENTS

This work was supported by the Korea Science and Engineering Foundation (KOSEF) grant funded by the Korea Government (MOST). (No. R01-2006-000-10277-0)

*Corresponding author: sshin@mju.ac.kr

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