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A heuristic adaptive QoS prediction scheme in single-hop passive star coupled WDM optical networks

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ABSTRACT

In this paper, a novel quality of service (QoS) prediction framework is proposed to accommodate different applications with various QoS requirements. The purpose of the proposed structure is to estimate, given the QoS requirements of different applications, the number of them can be satisfied according to the predefined QoS level and the number of them have to be rejected or accepted under lower level. Moreover, this structure is able to control the network behavior when the new application with certain QoS requirements requesting for the connection. The framework consists of four modules. *QoS Requirements Monitoring* detects the changes in the supplied QoS. *QoS Prediction* performs at real-time to estimate whether the new QoS can be adapted to the current QoS. *QoS Violation* is dedicated to detect the violation. And a module of *QoS Estimation* is used to make the decision whether the hopeless new traffic is refused or accepted with acceptable QoS requirements. Therefore, this structure is able to control network behavior when the surrounding environment changes. Numerical and simulation results obtained suggest that the proposed predictive scheme is a promising approach for real time QoS prediction.

1. Introduction

Wavelength division multiplexing (WDM) is emerging as a promising technology for utilizing the large bandwidth of an optical fiber. Several system structures have been proposed. A typical and simple topology is the one with a single-hop topology where a WDM optical network is configured as broadcast-and-select network to which all the inputs from various nodes are combined by a passive star coupler. And the mixed optical information is broadcast to all the destinations (Mukherjee, 1992).

Based on the hardware structure of a WDM optical network, multiple media access control (MAC) protocols are needed to schedule the messages to be transmitted through the multiple channels of the optical fiber. The protocols proposed on this system structure of WDM optical network could be divided into two different categories: the pre-allocation-based techniques as in Chlamatac and Ganz (1988); Ganz and Gao (1994); Rouskas and Ammar (1995); Azizoglu et al. (1996) and the reservation-based techniques as in Bogineni and Dowd (1992); Jia et al. (1995); Ma et al. (1999); Li and Qin (1998); Huang and Ma (2005a). The pre-allocation-based techniques assign transmission rights to different nodes in a static manner. While reservation-based techniques reserve one of the channels as the control channel to transmit the global information among all the nodes about the messages to be sent in the network and the other channels are used to transmit real messages. Our work in this paper focuses on the reservation-based technique.

Future network will be expected to support a wide variety of applications with various QoS requirements. QoS requirements are different for different types of applications. Even for the same types of application, different users may have different QoS requirements. Supporting QoS of diverse applications while efficiently utilizing the resources in single-hop passive-star coupled WDM optical networks is a challenging problem. Many research results (Yan et al., 1996; Ma et al., 1999; Huang and Ma, 2005b; Ma and Huang (2004); Bai and Ito 2007; Zhang and Sun, 2006; Wang and Lee, 2009) are published to provide real-time service in WDM optical networks as well as in some other networks. However, no scheme has been proposed so far to provide QoS prediction function, which is the main topic to be addressed in this paper.

To achieve acceptable QoS for each application, intelligent QoS prediction must be provided to ensure individual QoS objectives. QoS prediction is performed to study the percentage of services that fit into each of the QoS levels which have been defined based on the "satisfactory levels" of each application in the network. In this way, the network can estimate how many applications can be satisfied and to which level the QoS can be satisfied. Good predictions of the system can be run so that QoS degradation due to resource starvation will rarely happen. Furthermore, in the future generation network, one of the main challenges is providing flexible means for controlling network behavior as the surrounding environment changes. QoS service prediction is also an important topic

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