SUMMARY OF Ph.D. DISSERTATION

School Keio University	Student Identification Number	SURNAME, First name ARAKAWA, Yutaka

Title

Research on QoS Control Scheme in Broadband Photonic Network

Abstract

Rapid spreads of broad band access network, such as ADSL (Asymmetric Digital Subscriber Line) or FTTH (Fiber To The Home), is driving the explosive growth of IP traffic on the Internet, and the demands for new high-speed transport technologies. Wavelength Division Multiplexing (WDM), which can support a number of channels at Gigabit/s within a single optical link, has a capability of Terabit/s transmission. However, to realize an IP backbone network by WDM technology, switching capacity of electronic routers becomes a bottleneck because processing speed of routers does not catch up with transmission speed of an optical fiber. Optical burst switching (OBS) is focused on as a switching technique that can resolve above problem by concatenating multiple packets of the same destination into a single burst and transmitting together. OBS has advantages of switching efficiency for bursty IP traffic and optical hardware implementations. In OBS network, several IP packets with the same destinations are concatenated into a burst, and forwarded through the network in optical domain. The transmission of each burst is preceded by the transmission of a burst header packet, which usually takes place on a separate single channel. Recently, various new Internet applications, such as video phone or mp3 or VoD (Video on Demand), have been spread. It is expected that these applications require the different QoS classes provisioning in terms of burst loss rate, delay, throughput, etc, also in the backbone network.

In this paper, we propose new QoS control schemes for QoS differentiation and QoS equalization in OBS network. First, we propose a composite burst assembly scheme for providing the different burst loss rate. Second, we have been proposed OBS ring network architecture with upstream prioritized switching and fairness control for providing the fair

burst loss rate. By computer simulation, we show the effectiveness of our proposals.

In chapter 1, we describe the background and objective of this research, and refer the optical devices for realizing OBS, the basic technique of IP over WDM, and the history of WDM network architecture.

In chapter 2, we show the various conventional researches in OBS network; network architectures, node architectures, signaling methods, burst assembly schemes, etc. And the positions of our researches are summarized.

In chapter 3, we propose a new QoS control scheme by using burst dropping (BD) in optical burst switching. BD has been proposed as the effective solution that can improve packet loss at a burst contention by discarding the head of the latter arriving burst. At burst assembling, our proposed scheme mixes packets of different priorities into a single burst, and arranges them in ascending order of their priorities. At a contention, lower priority packets that are located in former part of a burst are often discarded. On the other hand, higher ones are not often discarded. By computer simulations, we show that our proposed scheme can provide a basic QoS in terms of packet loss without causing a degradation of end-to-end delay for higher priority packets.

In chapter 4, we propose an optical burst switched network architecture having upstream prioritized switching (UPS) and distributed fairness control. Burst dropping at intermediate nodes is the weakness of Optical Burst Switched network based on one-way signaling. In our proposed architecture, by performing UPS on the ring, on-the-fly bursts are never dropped at downstream nodes. However, UPS suffers from positional priority problem in that access nodes farther from the destination have higher priorities over those closer to the destination. Therefore, to keep fairness even if the traffic is unbalanced, we propose oLQF (OBS-extended Longest Queue First), which takes queuing time into account as well as its length. When a transmission is interrupted by a burst from upstream, a trailer packet is transmitted to alter down stream’s reservation. As a result, our architecture offers high throughput, and enhanced Fairness Index of to close to 1.

In chapter 5, conclusion of this paper is denoted.