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氏名	池田博樹（いけだひろき）
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学位論文名	Bandwidth Control and Its Design for Passive Optical Network （受動光ネットワークにおける帯域制御とその設計に関する研究）
論文審査委員	（主査） 教授　北山　研一 （副査） 教授　小牧　省三　　准教授　丸田　章博　　教授　滝根　哲哉 教授　井上　恭　　教授　馬場口　登　　教授　三瓶　政一 教授　河崎善一郎　　教授　鷲尾　隆　　教授　溝口理一郎

論 文 内 容 の 要 旨

This dissertation presents a study of dynamic bandwidth control and its design for passive optical networks. The content of the dissertation is based on the researches that have been carried out at Hitachi Ltd. and during doctoral course at the Division of Electronic, Information and Energy Engineering, Graduate School of Engineering, Osaka University. The dissertation is organized as follows.

Chapter 1 introduces the background of this thesis and provides the outline of the thesis.

Chapter 2 begins with fundamentals of passive optical networks (PONs) with polling technique to dynamically assign bandwidth of each optical network unit (ONU). A dynamic bandwidth allocation algorithm in the upstream direction is described. Finally design problems of bandwidth control for upcoming broadband services are described.

Chapter 3 proposes a session-based bandwidth control using the information of the Internet Protocol (IP) and data link layer for access networks and, presents its architectures of the session-based bandwidth control. This approach can be used in the current system, and can offer more flexible bandwidth control mechanism for the services.

Chapter 4 proposes a dynamic bandwidth allocation algorithm with an adaptive polling cycle. Firstly transport control protocol (TCP) performance and bandwidth utilization over PON systems is analyzed. Detail procedure and practical implementation of the algorithm are presented. Numerical evaluation results show that this dynamic polling approach can maximize TCP throughput, resulting in increasing the efficiency of the system in a 10Gigabit-Ethernet passive optical network (10G-EPON).

Chapter 5 proposes broadcasting system design that delivers multiple Internet protocol television (IPTV) broadcast channel to all ONUs by using broadcast links of the PON to carry multicast frames. System design for bandwidth allocation in the downstream direction to guarantee the quality-of-service (QoS) of IPTV is described. Performance evaluation results show that the broadcast link improves the number of IPTV channels per ONU. This approach can achieve broadband Internet and multiple high-definition (HD) IPTV broadcast services.

Chapter 6 summarizes all the conclusions obtained in this thesis.

論文審査の結果の要旨

This thesis has been presented a study on bandwidth control and its design for PON. The main results obtained in this thesis can me summarized as follows;

1. We have proposed system architecture for bandwidth and QoS over PON system. We have presented the basic architecture and algorithm of session-based SIP-QoS server that can manage the QoS policy for each media stream such video or audio in PONs for improving the usability of network resource. This approach can be used in the current system, and can offer more flexible bandwidth control mechanism for the services (Chapter 3).

2. We have proposed a dynamic bandwidth allocation algorithm with an adaptive polling cycle. Detail procedure and practical implementation of the algorithm has been presented. DBA-APC algorithm using a polling cycle control with a queue threshold can maximize the TCP throughput in an EPON. Numerical evaluation results have shown that DBA-APC can give the optimum polling cycle time to maximize TCP throughput, resulting in increasing the efficiency of the system in 10G-EPON. (Chapter 4).

3. We have proposed an IPTV broadcasting system architecture over PON that can achieve more than a 100-channel HDTV over fiber lines by adapting the broadcasting function of a PON to IP multicast networks. We have discussed the design method for the proposed system with a downstream bandwidth control for unicast links and broadcast link in a PON, and presented the bandwidth utilization efficiency and the effectiveness of the bandwidth allocation method for broadcasting links The implementation experiments have shown that the IP channel selection speed was less than 15 ms. Performance evaluation results have shown that the broadcast link improves the number of IPTV channels per ONU. (Chapter 5).

The judging committee admits that the thesis is worth the doctoral dissertation.