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Keio University

Thesis Abstract

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Thesis Title

A study of multicast on WDM optical network and IP network

Thesis Summary

With the increasing number of applications and devices making use of the network, the demand of high network bandwidth has been increasing sharply in the recent years. Although the advancement of different device technologies helps satisfying the demand, it involves a very high investment of equipments by the network service providers. The method of distributing data can also improve the usage efficiency of available network resources greatly. Multicast is a technique to deliver data from one point to multiple points effectively that the same stream of data is not sent more than once on the same path. Data stream is duplicated at the different branches of the network such that the data stream can be delivered to multiple destinations. The whole set of paths forms a multicast tree and this tree enables the efficient data delivery. However there are problems of how to allocate network resources on different layers of the network, and how to handle the complexity of the multicast delivery model.

Chapter 1 presents an introduction to the multicast data delivery. We will first introduce multicast in the Internet Protocol (IP) layer, including the related protocols which realize multicast data delivery. Next we introduce the reliable multicast, in which data has to be delivered correctly to the recipients correctly. Although a large application area multicast is multimedia data delivery in which some data loss is tolerable, there are increasing demands for reliability in multicast such as distributed computing. Structure of the multicast tree for reliable multicast and the data recovery techniques are discussed. Then we move on to introduce multicast tree in the optical network in which wavelength division multiplexing (WDM) technique is employed. In the optical WDM network resources are being allocated to different sessions. We discuss the issues and limitations on the WDM network in order to setup a multicast session.

Chapter 2 presents our proposed reliable multicast protocol using local retranmission and forward error correction (FEC) based on group-aided multicast (GAM) scheme. In reliable multicast, feedback and recovery traffic limit the performance and scalability of the multicast session. In our scheme, we improve the original GAM by making use of FEC locally in addition to NACK/retransmission in its local-group based recovery. Our scheme produces FEC packets and multicasts the packets within the scope of a local group in order to correct uncorrelated errors of the local members in each group of the multicast session, which reduces the need for NACK/retransmission. By using our scheme,

redundancy traffic can be localized in each group within a multicast session, and the overall recovery traffic can be reduced.

Chapter 3 explains the proposed scheme for multicast routing and wavelength assignment for dynamic multicast sessions in WDM network using minimum Δ. In this scheme a light-tree for dynamic multicast session for the WDM network is established by choosing the wavelength that leads to a reduction in blocking probabilities by using a parameter Δ. Δ is defined as the overall reduction of connectivity of the nodes in the network caused by a wavelength assignment process when using a particular wavelength, and we assign wavelength resources to the multicast session by choosing the Δ which leads to smallest reduction in connectivity. Through computer simulation, we show that the proposed scheme has lower blocking probabilities when compared with minimum cost scheme under the condition that wavelength conversion is not allowed.

Chapter 4 concludes this dissertation with an overall discussion of the multicast data delivery and techniques discussed throughout the report.