Generalized Clos Networks for Packet Switching

Joseph Hui
Department of Electrical Engineering
Arizona State University
Tempe, AZ 85287
Email: jhui@asu.edu

Abstract

The advent of high bandwidth applications such as IPTV requires ten Mb/s per TV signal and multiple Terabit per second switching. Such applications are best transported by large packets exceeding 1 kilobyte size. Large packet size incurs insignificant queuing or packetization delay, since link and application data rates are high. More significantly, large packets are more efficiently handled at the receiving and transmitting operating systems. The premise of this talk is the abandoning of switching small data units such as ATM cells in favor of switching networks for large and possibly asynchronous packets. Smaller packets are routed through intermediate concentrating nodes where packets for the same destination are multiplexed.

Clos networks are particularly suitable for terabit switching due to simplicity of network and control. We categorize various types of Clos network regarding the use of buffering in selected stages. For example, we may have share buffering in the first and third stages, buffering in the second stage only, or no buffering in all three stages. We also categorize control algorithms according to whether they are synchronous or not, or whether they are distributed or centralized. Packets may be switched asynchronously across switch inputs. Distributed switching mimics step by step switching, or may use the 3 phase algorithm of probing, acknowledgement and sending. An example of centralized control is the looping algorithm.

We analyze the throughput performance of each of these categories. We also demonstrate control algorithms which allow faster connection setup.