RATE ESTIMATION AND FLOW CONTROL OF BEST EFFORT TRAFFIC IN HETEROGENEOUS NETWORKS

by

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Submitted
in fulfillment of the requirements of the degree of Doctor of Philosophy

to the

INDIAN INSTITUTE OF TECHNOLOGY, DELHI
JULY 1999

Certificate

This is to certify that the thesis titled "Rate Estimation and Flow Control of Best Effort Traffic in Heterogeneous Networks" being submitted by R. N. Moorthy to the Indian Institute of Technology, Delhi, for the award of the Degree of Doctor of Philosophy, is a record of bonafide research carried out by him under my guidance and supervision. The results obtained in this thesis have not been submitted to any other University or Institute for the award of any other degree or diploma.

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Acknowledgments

This dissertation exists because of the help and comfort from many sources. I can at best mention only some of them. To all the others not mentioned here please accept my thanks.

It has been my privilege to work under the direction of Professor B. N. Jain. He has given me the needed technical guidance, sufficient encouragement and support. His vision, insight, endeavor for perfection, insistence on clarity of exposition and presentation has enabled me to develop and complete the documentation of the research work. Each and every discussion with him resulted in renewed thinking for me. His diligence in reading the series of drafts has always been beyond my expectations.

I owe my sincere regards towards research scholars, faculty members and staff of the Department of Computer Science and Engineering for providing a pleasant and helpful environment which had a profound impact on this thesis. I am indebted to Prof S. N. Maheshwari who perpetually encouraged me and each discussion with him always resulted in a new enthusiasm. I owe a great deal of thanks to Dr. Huzur Saran who was kind enough to read perpetual drafts and provided fresh inputs on a number of occasions.

My sincere thanks go to all my friends. It was my fortune to have Ram P. Rustagi as my friend and colleague, who always rightly advised me during any crisis. Bindu Chandan, Rajiv Jain, and Rahul Garg deserve big thanks for providing me the very much needed last minute support. At ERNet lab, where I carried out most of my research work, I was fortunate to have made a number of good friends who made the place more enjoyable: Surinder Singh Anand, Sunay Tripathi, Suresh Prasad Singh, Neena Pahuja, Rekha Goel and Manivannan Aru.

I am greatful to REC Trichy who not only granted me the necessary leave but also provided me the full financial support without which this research work may not even have started.

Most valued of all are my wife Shanthi and my daughters Aarthi and Preethi. They have given me an incredible amount of love and caring. I would also like to mention the love, affection and concern of my parents all through.

R.N. Moorthy

Abstract

We show that in a BE connection, the mean inter-packet arrival time at the destination is a monotonically increasing function of mean inter-packet departure time at the source. Also, we define a most important parameter of the connection, denoted by τ^b, as the smallest value of inter-packet departure time for which the mean inter-packet arrival time equals that of the inter-packet departure time.

The characterization of a connection may be used to estimate τ^b and control the sending rate of the connection. We present an implicit end-to-end rate based flow control policy based on this characterization, for best effort connections in heterogeneous network which is an interconnected set of networks that use traditional packet switching or implement ATM like protocols. The intermediate switches may use a FCFS or a rate allocating packet scheduling discipline such as Fair Queuing. Although our scheme is presented in the context of a connection oriented network it is also applicable in a datagram network, such as the Internet (assuming routing changes take place over time scales significantly larger than a few round-trip times).

An important characteristic of the proposed scheme is that it assumes no support from the underlying network and lower layers to indicate or control congestion, but instead uses the mean spread of sets of uniformly spaced packets to measure the available bandwidth at the bottleneck server (switch/router) along the path of a connection. This estimate of available bandwidth is then fed to a controller which adjusts the sending rate so as to maintain a certain number of packets buffered at the bottleneck server.

The proposed Rate Estimation and Control scheme is studied extensively using simulations. Results obtained from simulation experiments show that the scheme can adapt quickly to changes in bandwidth available to best effort traffic and

consequently utilizes the resources at the servers better and loses fewer packets than TCP, the classical end-to-end control scheme. Our simulation results show that in the case of multiple competing connections using the proposed scheme, the available bandwidth is distributed equitably.

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