Chapter 8
Mechanisms for Parallel Data Transport

Jewel Okyere-Benya
Eindhoven University of Technology, the Netherlands & Politecnico di Torino, Italy

Georgios Exarchakos
Eindhoven University of Technology, The Netherlands

Vlado Menkovski
Eindhoven University of Technology, The Netherlands

Antonio Liotta
Eindhoven University of Technology, The Netherlands

Paolo Giaccone
Politecnico di Torino, Italy

ABSTRACT

Evolving paradigms of parallel transport mechanisms are necessary to satisfy the ever increasing need of high performing communication systems. Parallel transport mechanisms can be described as a technique to send several data simultaneously using several parallel channels. The authors' survey captures the entire building blocks in designing next generation parallel transport mechanisms by firstly analyzing the basic structure of a transport mechanism using a point to point scenario. They then proceed to segment parallel transport into four categories and describe some of the most sophisticated technologies such as Multipath under Point to Point, Multicast under Point to Multipoint, Parallel downloading under Multipoint to Point, and Peer to Peer streaming under Multipoint to Multipoint. The Survey enables the authors to stipulate that high performing parallel transport mechanisms can be achieved by integrating the most efficient technologies under these categories, while using the most efficient underlying Point to Point transport protocols.

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INTRODUCTION

As Internet traffic increases, the use of sophisticated network and data transport technologies are required to meet the demands of today's Internet. These efforts have been boosted by the advent of Peer to Peer (P2P) networks. Even though P2P has the potential to address bandwidth problems faced by End Users, Content Providers, Internet Service Providers (ISP's), and Equipment Vendors, parameters such as Delay, QoS and packet loss still depend on the underlying technologies. Numerous data transport mechanisms, e.g. resource reservation protocols, can fairly solve the problem, but are unutilized or often too expensive to replace installed equipment. Parallel data transport holds the key to solving these problems and there has been tremendous amount of research in the field.

A huge percentage of the point to point communication in the Internet is made up of reliable transport mechanisms. Our initial study gives attention to literature in building simple unreliable point to point connections, and introduces features for building reliable point to point connections. We make an exhaustive overview of each feature especially Congestion management, and elaborate on new and bandwidth efficient techniques which uses network delay to manage congestion such as Low Extra Delay Background Transport (LEDBAT).

A single path or connection between two nodes is suboptimal compared to one with multiple paths or multiple connections. Our study of parallel transport begins here by analyzing several techniques to build multiple connections and multiple paths between Point to Point connections. Most TCP extensions enable setting up multiple connections. While multiple connections are good, discovering multiple paths between point to point connections and combining both over a single connection improves its fault resilience and bandwidth efficiency. Techniques such as Multi-homing, that can bind multiple IP addresses at each node, which in turn provides a network interface redundancy, have also been discussed. Other techniques also captured include multilayer approaches such as Parallel TCP Transfer Helper (PATHEL) which can exploit interlayer benefits to strip the data flow among multiple TCP channels.

Computer applications which support group communication require parallel transport mechanisms that enable Point-Multipoint and Multipoint to Point communication. Under Point to Multi-point techniques, we will present some advance work on multicasting used in content delivery systems. This would include underlying architectures and mechanisms used for both IP multicast and Application Layer Multicast. A computer seeking to exploit the upload bandwidth of several other computers to improve its download capability falls into the Multi-point to Point parallel transport paradigm. Parallel downloading, as it is usually known, can significantly improve performance through a parallel access scheme, but this might come with some cost such as delays incurred by complex client server negotiations. Therefore a good parallel downloading system should consider these costs in its design.

Application layer services such as video streaming can be described as some of the currently most advance parallel transport mechanisms. Such streaming services are based or either structured or unstructured P2P overlay networks depending on the survivability of data files and the distributed nature of the network. P2P Video streaming provides the best platform for next generation Multi-point to Multi-point transport mechanisms because it supports technologies such as Adaptive streaming, Layered streaming and caching in P2P networks. To achieve the best performance, it is important to integrate these underlying schemes into one complete protocol as done in the "BitTorrent DNA" protocol. BitTorrent DNA is designed to deliver high performance for content delivery systems by providing (i) multiple video streams for multiple users with different bandwidth requirements, (ii)