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村田健史（情報通信研究機構）

HPCと高速通信技術の融合による大規模データの拠点間転送技術開発と実データを用いたシステム実証試験

Overview

- Problem Statement

Nowadays, a variety of research areas such as remote sensing systems, satellites for disaster resiliency, and 4K/8K video transmission systems require high-speed data transfer over long-distance networks. Several data transfer protocols, which are based on either transmission control protocol (TCP) or user datagram protocol (UDP), have been introduced for high bandwidth networks. However, only a few protocols have ever succeeded in higher throughput than 10 Gbps in long-distance networks with packet loss, thus many effective applications have not yet introduced in these networks.

- Our Contributions

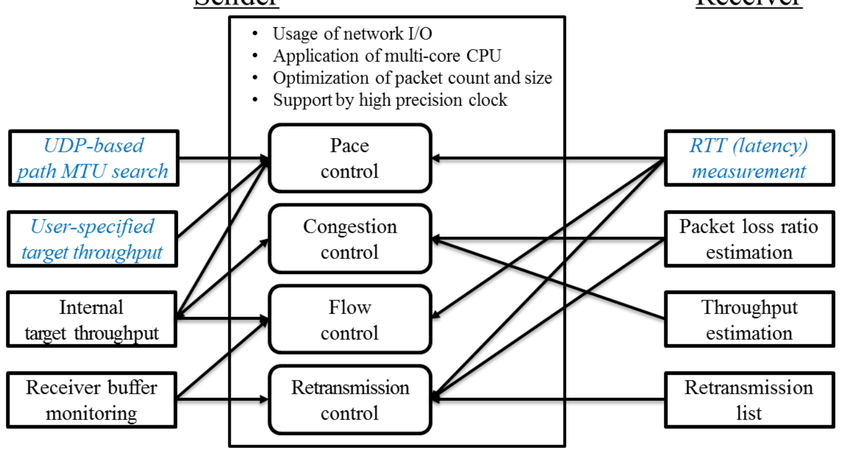
We develop two techniques for high-speed data transfer for long-distance networks with packet loss. The first is a novel high-speed data transfer protocol, named high-performance and flexible protocol (HpFP). The second is a wide area network (WAN) optimization and acceleration, named xTCP.

xTCP

- WAN Optimization and Acceleration (TCP)
- Optimize bandwidth to improve the end user's experience on a WAN
- Operation in four different modes
  - Aggressive mode: to maximize its own throughput without regard to fairness or network stability
  - Fair mode (normal): to maintain the fairness among all network connections and balance the speed of each network connection by gradually increasing the amount of data transmitted until it finds the network's maximum carrying capacity
  - Fair mode with quick start: to improve the properties of fair mode by providing a fast and stable experience
  - Modest mode: to improve the estimation of the fair transmission rate and prevent the rate oscillation which is occurred by the aggressive mode

HpFP

- Built on the top of UDP
- Connection-oriented and reliable stream-type protocol
- Socket library working on user lands
- Supported on both Windows and Linux platforms
- Applications: hperf and hcp



Note *italic text* denotes parameters measured at the initial moment.

Fig. 1 Overview of HpFP controls

Laboratory Experiment

- HpFP and xTCP achieve better performance than TCP in network with packet loss.

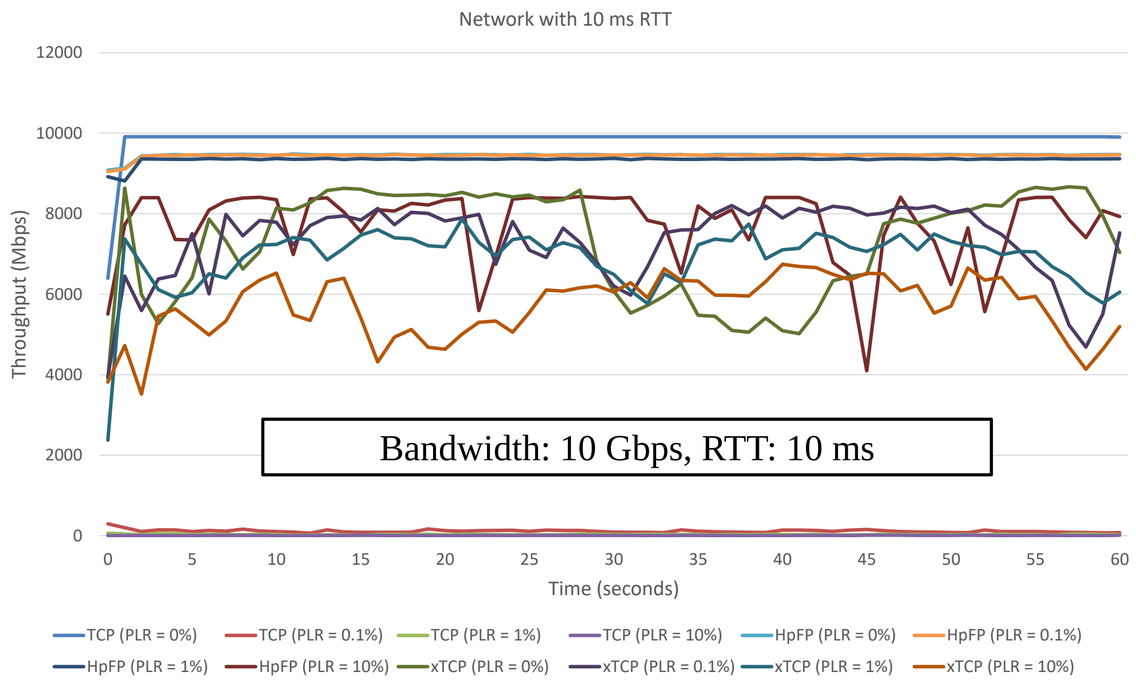


Fig. 2 Throughputs of TCP, HpFP, and xTCP

JHPCN Experiment

- Bandwidth: 1 - 10 Gbps
- RTT: 2 - 18 ms
- Throughput can be improved using HpFP and xTCP.

Table 1 Throughput improvement ratio of HpFP over TCP (CUBIC)

		Receiver					
		NICT	Kyushu-u	Ehime-u	Kyoto-u	Chiba-u	Tsukuba-u
Sender	NICT	-	**10.21** (786/77 Mbps)	**7.14** (800/112 Mbps)	×	**1.92** (751/391 Mbps)	**2.04** (776/381 Mbps)
	Kyushu-u	×	-	**1.07** (867/808 Mbps)	×	×	**8.26** (2577/312 Mbps)
	Ehime-u	×	0.9 (791/880 Mbps)	-	×	0.97 (799/821 Mbps)	**1.04** (800/772 Mbps)
	Kyoto-u	×	**7.97** (2732/343 Mbps)	**2.17** (862/397 Mbps)	-	**6.25** (1576/252 Mbps)	**20.66** (2211/107 Mbps)
	Chiba-u	×	**1.98** (2838/1432 Mbps)	**1.02** (833/814 Mbps)	×	-	0.29 (2747/9431 Mbps)
	Tsukuba-u	×	**1.44** (2006/1397 Mbps)	**1.03** (815/790 Mbps)	×	×	-

: 10 Gbps region

- Future works
  - Finish the experiments of all members of JHPCN
  - Improve the performance of xTCP

Table 2 Throughput improvement ratio of xTCP over TCP (CUBIC)

		Receiver					
		NICT	Kyushu-u	Ehime-u	Kyoto-u	Chiba-u	Tsukuba-u
Sender	NICT	-	×	**2.4** (269/112 Mbps)	×	**1.76** (689/391 Mbps)	**1.99** (757/381 Mbps)
	Kyushu-u	×	-	×	×	×	×
	Ehime-u	×	×	-	×	0.99 (810/821 Mbps)	**1.07** (829/772 Mbps)
	Kyoto-u	×	×	×	-	×	×
	Chiba-u	×	×	0.95 (773/814 Mbps)	×	-	0.37 (3491/9431 Mbps)
	Tsukuba-u	×	×	0.66 (521/790 Mbps)	×	×	-

: 10 Gbps region

Collaborating Researchers
Praphan Pavarangkoon[1], Kazunori Yamamoto[1], Kazuya Muranaga[2], Takamichi Mizuhara[3], and Eizen Kimura[4]
[1]National Institute of Information and Communications Technology, Tokyo, Japan,
[2]Systems Engineering Consultants Co., Ltd., Tokyo, Japan
[3]CLEALINKTECHNOLOGY Co., Ltd., Kyoto, Japan
[4]Department of Medical Informatics, Ehime University, Ehime, Japan