Title: High Efficient Data Center in Smart City: A Survey of TCP Incast Solutions to Improve Data Center Network Performance

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Abstract

The smart city concept is no longer just a science fiction idea. However, as fully integrated smart cities emerge, existing data infrastructure, especially for data centers, will be put under tremendous strain. With the vast amount of data being collected on a regular basis and the intense computing demands of AI-driven machine learning analytics, the sheer volume of traffic and processing workload will force networks to optimize or collapse under their own weight. Additionally, the increasing popularity of internet applications and the demands of many-to-one transmission in data center networks (DCNs) will result in a large number of packets being injected into the switch at the same time, competing for the same output port. This can cause the bottleneck buffer to overflow and many packets must be dropped. Furthermore, the proximity of servers in data centers can result in a very short packet round-trip time, leading to depressed network performance if the retransmission timeout timer is not set correctly. This issue is known as TCP Incast.

To address this problem, we present a comprehensive survey of TCP Incast solutions in DCNs. We develop a classification scheme based on multiple levels of criteria, including the TCP/IP protocol stack and various sublevel classifications such as loss-based congestion control, delay-based congestion control, and probabilistic schemes. We evaluate each solution's performance in terms of its ability to alleviate network congestion during incast conditions, highlighting their respective strengths and weaknesses. Finally, we outline the open challenges and issues in mitigating TCP Incast in DCNs, which we believe will serve as a valuable guide for researchers and engineers in designing future DCN protocols.

Biography

Dr. Cheng-Yuan Ho is an Associate Professor in Department of Information Management, National Taiwan University. He received his Bachelor degrees in Mathematics (Major), and Information and Computer Education (Minor) from National Taiwan Normal University in 2003, and the Ph. D. degree in Computer Science from National Chiao Tung University (NCTU) in 2008.
He was a winner of Microsoft Fellowship 2005. In 2006, he was an intern and worked for the Wireless and Networking Group of Microsoft Research Asia, Beijing, China. During this period, he assisted in developing Compound TCP (CTCP), which is embedded in Windows XP, Vista, 7, 8, and 10, Windows Server 2003, 2008, and 2016, and Linux.
He was a postdoctoral researcher of D-Link NCTU Joint Research Center at NCTU from July 2008 to July 2010 and an assistant researcher of Microelectronics and Information Systems Research Center under NCTU's Diamond Program from August 2010 to July 2011. He worked at Advanced Research Institute (ARI) at Institute for Information Industry (III) as a R&D manager from July 2011 to November 2014. He joined LOFTechnology, Inc. as a business operation manager from November 2014 to January 2017. Dr. Ho was an Associate Professor in Department of Computer Science and Information Engineering, Asia University from February 2017 to July 2022.
His main research is focusing on computer networks, network protocols and algorithms, artificial intelligence in applications, big data (especially transportation information analysis), and Internet of Things (IoT).

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