Measuring TFRC & SCTP Performance over AODV in MANET

Omar Dakkak

UNIVERSITI UTARA MALAYSIA

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ABSTRACT

This study focuses on TCP-Friendly rate control (TFRC), which is defined by IETF in RFC 5348 as and Stream Control Transmission Protocol (SCTP), which is defined by IETF in RFC 4960 as a new transport protocol. TFRC feature as fairness has attracted real time application and SCTP features also as multi-homing and multi-streaming, has attracted multimedia applications to use it as their transport protocol instead of TCP and UDP. However, the challenge faced by TFRC that is using additive increase to adjust the sending rate during periods with no congestion. This leads to short term congestion that can degrade the quality of voice applications. SCTP faced the challenge in a best-effort network. In this study, a comprehensive performance evaluation between TFRC and SCTP has been carried out. The objectives of this research are to measure the performance of both TFRC and SCTP in MANET in terms of throughput, delay and packet loss that has TFRC and SCTP with UDP traffic some times and some experiments without UDP and the nodes is in mobility positions. All experiments conducted in this research were obtained through network simulation tools using NS-2. It is expected that this study is useful for researchers in improving both TFRC and SCTP.

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LIST OF APPREVIATION

AIMD	Additive-Increase Multiplicative-Decrease
AODV	Ad hoc On-Demand Distance Vector
ARPA	Advanced Research Projects Agency
BSD	Berkeley Software Distribution
CH	Cluster-Head
FTP	File Transfer Protocol
GPS	Global Positioning System
HOL	Head of Line
HTTP	Hypertext Transfer Protocol
IAP	Internet Architecture Board
IETF	Internet Engineering Task Force
IP	Internet Protocol
JTRC	Joint Tactical Radio System
LOS	Line of Sight
MANET	Mobile Ad-hoc Network
NAM	Network Animator
NCW	Network Centric Warfare
N-LOS	Non-Line of Sight
NSF	National Science Foundation
NS-2	Network Simulator-Version 2
OTcl	Object-oriented Tool Command Language
QOS	Quality of Service
RF	Radio Frequency
RTP	Real Time Protocol
RTT	Round-Trip Time
SCTP	Stream Control Transmission Protocol
SMTP	Simple Mail Transfer Protocol
TCL	Tool Command Language
TCP	Transmission Control Protocol
TFRC	TCP-Friendly Rate Control
TFRC-TB	TCP Friendly Rate Control-Token Bucket
UAV	Unmanned Aerial Vehicle
UDP	User Datagram Protocol
VINT	Virtual Inter Network Testbed
VOIP	Voice over IP
WSN	Wireless sensor networks

ORGANIZATION OF THE REPORT

This report consists of five chapters which cover discussing, simulation and performance evaluation. Here is an overview of the content of each presented chapter:

Chapter One: This chapter introduces the problem, gives an overview about the study. This chapter also discusses the scope of the study, the significance of the study and its objectives.

Chapter Two: This chapter covers the literature review which is the previous related works that been done before. Moreover, this chapter represents relevant information for understanding the study more.

Chapter Three: This chapter explains the details of the selected methodology that we have used in the project.

Chapter Four: This chapter discusses about the performance evaluations which contain the setup for experiments, simulation itself, results and result discussion.

Chapter Five: This chapter provides total comparison between TFRC and SCTP in all cases according to throughput, delay and packet loss.

Chapter Six: This chapter provides discussing about the findings, contribution, limitation of the study and Future work.

CHAPTER ONE

INTRODUCTION

1.0. Background

Networking complexity has led to the modularization of network architecture in layers. Traditional approaches focus on wired networks and try to separately optimize each network layer such as the physical, the medium access, the routing and the transport layer. This approach reduces the complexity and makes issues more manageable and architectures more flexible and upgradeable, but it may lead to suboptimal designs. Under this layered approach, communication occurs between two adjacent layers without taking into consideration the specific characteristics of multimedia applications. Although this layered approach has been the fundamental factor for the growth of the wired networks and the World Wide Web it seems to pose constrains when attempting to adapt protocol's behavior to multimedia applications characteristics and to wireless network conditions. Therefore, a careful cross-layer approach, where selected communication and interaction between layers is allowed, can have performance advantages without negating the successful layer separation that has guided network design so far. A theoretical discussion of the cross-layer problem framework can be found at (Schaar & Shankar, 2005).

1.1. Problem Statement

Variety of protocols and its function made the network developers confusion. So many protocols appeared in different networks environment, that's result to maze about what is the suitable protocol for each network and application.

The contents of the thesis is for internal user only

REFERENCES

Amer, P., & Stewart, R. (2005). Why is SCTP needed given TCP and UDP are widely available? Virginia, USA: http://www.isoc.org/briefings/017/, copyright C Internet society.

Beritelli, F., Ruggeri, G., & Schembra, G. (2002). *Tcp-friendly transmission of voice over IP*, in International Conference on Communication (ICC).

Brutch, P., & Ko, C. (2003). *Challenges in Intrusion Detection for Wireless Ad-hoc Networks.* Applications and the Internet Workshops.

Carson, S., & Maker, J. (1999, January). Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations. Retrieved from The Internet Society.

Chung, J., & Claypool, M. (2003). *Ns by example*. Retrieved from http:// nile.wpi.edu/NS/.

Demichelis, C., & Chimento, P. (2002). *IP Packet Delay Variation Metric for IP Performance Metrics (IPPM).* RFC 3393, 6-13.

Floyd, S., & Kempf, J. (2002). *Iab concerns regarding congestion control for voice traffic in the internet*, RFC 3714.

Greis, M. (2002). *Tutorial for the Network Simulator NS2*. Retrieved from http:// www.isi.edu/nsnam/ns/tutorial/.

Handley, M., Floyd, S., Padhye, J., & Widmer,J. (2000). *TEquation-based congestion control for unicast applications: the extended version*, in Special Interest Group on Data Communications (SIGCOMM '00), Stockholm, Sweden.

Handley, M., Floyd, S., Padhye, J., & Widmer,J. (2002). *Tcp friendly rate congestion control (tfrc): protocol specification*, RFC 3448.

Hassan, M., & Jain, R. (2004). , Chapter 4 page:-by Pearson Education, Inc, Pearson Prentice Hall, Upper Saddle River, NJ07458. In High Performance TCP/IP Networking (pp. 76-79). USA: Alan R. Apt.

Hunt, C. (1997). TCP/IP protocol architecure. *In TCP/IP network adminstration (pp. 9-23)*, Sebastopol CA, USA: O'Reily Media.

Issariyakul, T., & Hossain, E. (2009). Introduction to Network Simulator NS2, Springer Science+Business Media, LLC 2009. doi : 10.1007/978-0-387-71760-9 1.

Jansen, W., Mell, P., Karygiannis, T., & Marks, D. (1999). *Applying Mobile Agents to Intrusion Detection and Response*, National Institute of Standards and Technology Computer Security Division, NIST Interim Report (IR) - 6416.

Joe, I.,& YAN, S. (2009). SCTP throughput Improvement with Best Load Sharing based on Multihoming. *Fifth International Joint Conference on INC, IMS and IDC (pp. 1-5).* Seoul, Korea: IEEE Computer Society.

Kuhl, M., Kistner, J., Costantini, K., & Sudit, M. (2007). *Cyber attack modeling and simulation for network security analysis, 39th conference on Winter simulation by ACM* (pp. 1-9), IEEE Computer Society.

Kurose, J. F. & Ross, K. W. (2010). *Computer Networking: A Top-Down Approach. New York: Addison-Wesley*. P 30y

Maldonado, M., Abdul Baset, S., & Schulzrinne, H. (2005). *TCP-Friendly Rate Control with Token Bucket for VoIP Congestion Control*, Department of Computer Science Columbia University

Peacock, A. (2007). *CONNECTING THE EDGE: Mobile Ad-Hoc Networks (MANETs) for Network Centric Warfare*, Blue Horizons Paper Center for Strategy and Technology, Air War College.

Phelan, T. (2004). TFRC with Self-Limiting Sources, Sonus Networks.

Postel, J. (1980). *User Datagram Protocol*, RFC 768, August.

Postel, J. (1981). *Transmission Control Protocol*, RFC 793.

Rejap, M.R.A, Zaini, K.M., Azzali, F. Tahir, H. (2010). *An Investigation of TFRC over AODV and DSR Routing Protocols*, School of Communications and Computer Engineering, UUM College of Arts and Sciences.

Santi, P. (2005). *Topology Control in Wireless Ad Hoc and Sensor Networks.* Italy: Ltd, 90 Tottenham Court Road, London W1T 4LP, UK. Applications.

Schaar M. van der., & Sai Shankar N.D. (2005). *Cross-layer wireless multimedia transmission: Challenges*, principles and new paradigms, IEEE wireless Communications.

Sjoberg, J., Westerlund, M., Lakaniemi, A., & Xie, Q. (2003). *Real-time transport protocol (rtp) payload format and file storage format for the adaptive multi-rate (amr) and adaptive multi-rate wideband (amr-wb) audio codecs*, RFC 3267.

Stewart, R. (2007). Stream Control Transmission Protocol, RFC 4960.

Stewart,R., T¨uxen, L., & Lei, K. (2007). *Stream Control Transmission Protocol Dynamic Address Reconfiguration*, RFC 5061.

Tsaoussidis, V., & Badr, H. (2000). *TCP-Probing: Towards an Error Control Schema with Energy and Throughput Performance Gains*, 8th IEEE Conference on Network Protocols, Japan.

USC (2001). *USC supports Network Simulator software*. Retrieved from http://nsnam.isi.edu/nsnam/index.php/Contributed Code

USC (2002). *USC supports Network Simulator software*. Retrieved from http://nsnam.isi.edu/nsnam/index.php/

USC (2004). *USC supports Network Simulator software*. Retrieved from http://www.isi.edu/nsnam/ns/

Widmer, J., Robert Denda, R., & Mauve, M. (2001). *A survey on TCP-friendly congestion control.* Special Issue of the IEEE Network Magazine ``Control of Best Effort Traffic, 15(3):28 - 37.

Zhang , C., & Tsaoussidis, V. (2001). *TCP Real: Improving Real-time Capabilities of TCP over, Heterogeneous Networks*, 11th IEEE/ACM NOSSDAV, NY.